JOURNAL OF THE AERONAUTICAL SCIENCES

AERONAUTICAL REVIEW SECTION

VOLUME 8 MARCH, 1941 NUMBER 5

Skill

FOR AMERICA'S DEFENSE

Machinists in the making—quick to learn, eager . . . much of the future security of America depends on these young men who are building their success around the sound lesson of coordinated hand and mind.

The skill of Wright's thousands of "old timers," painstakingly acquired through many years of service to the aviation industry, is being transfused into young America to give greater strength and new vitality to industrial progress and to National Defense.

Wright Aeronautical Corporation, Paterson, New Jersey
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Concurrent with its training program, Wright has increased its production to more than 1,100,000 H. P. per month, will double this figure in 1941.

WRIGHT
Aircraft **ENGINES**

JOURNAL OF THE AERONAUTICAL SCIENCES

AERONAUTICAL REVIEW SECTION

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THE DEFENSE IS ALERT

IN anti-aircraft defense, threatening airplanes must be located with utmost speed. To solve this problem Sperry has developed the Sound Locator or "mechanical ear" by which the defense can determine the location of on-coming airplanes and their direction of flight.

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Aviation Writing Comes of Age

IF THE AERONAUTICAL REVIEW may speak for the entire aeronautical profession, we believe that by unanimous consent *Fortune* deserves the accolade of appreciation which is being expressed by everyone who has read the March issue, which is devoted entirely to aeronautical developments.

The original illustrated news story about the Wrights at Kitty Hawk was as crude as the airplane it described. "Navigator's car," six-bladed propellers at "diverse angles," "fan-shaped rudder sticking out from center," are typical of its inaccuracies. Aviation has come far since the days of Kitty Hawk, and so has the graphic presentation of aviation *via* the printed page.

The Aviation issue of *Fortune* for March has the power, beauty, and technical excellence of the modern aircraft industry it so ably presents. Editorially it surpasses any similar effort made by any other publication. Pictorially it is worthy of an academy award. Its scientific accuracy will delight the hearts of many in an industry whose passion for and appreciation of accuracy is unequalled.

That *Fortune* should treat aviation exclusively in an entire issue indicates the rapid growth and vitality of this young industry. Our sincere compliments to *Fortune*'s editors for their foresight and skill in presenting aviation to the public. It shows that aviation writing, too, has come of age.

Books Versus Bombs

What may prove to be one of the major losses in the German bombing of London, was the total destruction of some 6,000,000 volumes in the three-hour fire-bombing of Paternoster Row and the surrounding center of Great Britain's book publishing industry, on December 29th. This appalling loss of both modern and ancient works, many of them irreplaceable, was sustained in an area not a quarter of a mile square, mainly north of and around St. Paul's Cathedral, including Paternoster Row, Paternoster Square, Amen Court Stationers' Hall Court, Ave Maria Lane, Warwick Lane and part of Ludgate Hill.

A first-hand description of the area, the day following the raid, by Petrel, commentator for the London Bookseller, appeared in the January 2nd issue of that publication. "There was nothing left to recognize," he wrote. "Such a scene of destruction I have never seen or imagined. In publisher's basements on Monday afternoon, glowed and shuddered the remnants of a million books. Gusts of hot air and acrid smoke blew across the streets, and around the outskirts of the devastation played the jets from the firemen's hoses. From Warwick Square on the west to Ivy on the east, from Paternoster Row to Newgate Street, there lies now an undulating sea of broken yellow bricks. As I picked my way gingerly across from brick to brick, hot gusts of sulphurous fumes from buried fires seeped up between my feet; desultory flames played on the remains of a rafter here or a floor joist there, and on either side the smoking causeway fell sharply away into cavernous glowing holes, once basements full of stock, now the crematories of the City's book world. Here and there half a wall still stood in dangerous solitude, two or three stories high, giving form and significance to the desolation, and that was all. In the distance water hissed and rafters crackled, but near me the silence was almost absolute. London silence is always rather strange and unnatural; but London dead, burnt and buried with such staggering completeness, I found weird, oppressive and uncanny in the extreme."

"Seven years have passed since the Nazis made their first bonfire of books in Germany. Maybe now, however, they have lit a larger fire than they think. If it is to be an ordeal by fire, we know how to take it. Give us ten thousand incendiary bombs raining down on our homes, our shops, our warehouses, rather than a single bleak, obscene flame of book burnings in the village green."

Edward R. Murrow, CBS correspondent, broadcasting from London January 13th, said, "Paternoster Row, traditionally the center of publishing, is gone. It is a prophetic monument to the new culture. Given sufficient demand, popular books can be reprinted more quickly than the Germans can destroy. It is the scholarly books and rare editions that are lost."

Now comes news that the British publishing industry is already at work planning reorganization and reconstruction. Their "ordeal by fire" faced in that spirit cannot fail to produce a better world of tomorrow. We extend our every wish for the bright future their fortitude so richly deserves.

An Appreciation to Corporate Members of the Institute of the Aeronautical Sciences

Listed below are the leading aeronautical and industrial companies who make possible the publication of the *Journal of the Aeronautical Sciences* through Corporate Membership Dues.

The income from these dues enables the Institute to publish scientific and technical papers in the first section of the Journal without advertising and to devote its pages exclusively to editorial material.

The *Aeronautical Review* is devoted to the dissemination of current aeronautical information of a broader scope and is supported by its advertisers and The Paul Kollsman Library Fund. This library lends aeronautical books and sends them by mail, without charge, to aeronautical specialists in any part of the United States.

The above services provide a source of comprehensive technical information for the benefit of the aeronautical profession and industry.

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- Pratt & Whitney Aircraft
- Vought-Sikorsky Aircraft Division

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United States Aviation Underwriters

Westinghouse Electric and Mfg. Company

Wyman-Gordon Company

BOOKS

Books reviewed in this section may be purchased, or borrowed without charge, from The Paul Kollsman Library, Institute of the Aeronautical Sciences, 1505 RCA Building West, Rockefeller Center, New York, N. Y.

Graphic History of Aviation

Whenever a new history of the art and science of aeronautics appears, the author is subjected to critical examination as to his accuracy, impartiality and the scope of his work. By all these tests this book fulfills the obvious effort of the former editor of Aviation Magazine to be objective and sincerely informative.

His divisions of the book are commendable. He takes balloons, airships, autogiros, gliders, airplanes and follows each from its origin to the present. This gives a much clearer idea of the development of the art than by using the interwoven chronological method.

Aviation is fortunate in being rich in pictorial records and exceptionally careful selection has been used in presenting the reader with a series of illustrations which supplement the text to the great enhancement of interest.

For anyone, either young or old, who wishes to learn how man acquired mastery of the air "Horizon Unlimited" gives a readable and interesting account up to the present time. The author's many years of close observation and intimate knowledge of aviation give the book an authoritative background which will be recognized by those who have made a special study of the historical development of flight. Not the least valuable contribution in the book are the author's drawings which give simple and clear explanation of technical problems that become involved when put in words.

Horizons Unlimited, by S. Paul Johnston; Duell, Sloan & Pearce, Inc., New York 1941; 354 pages, $3.75.

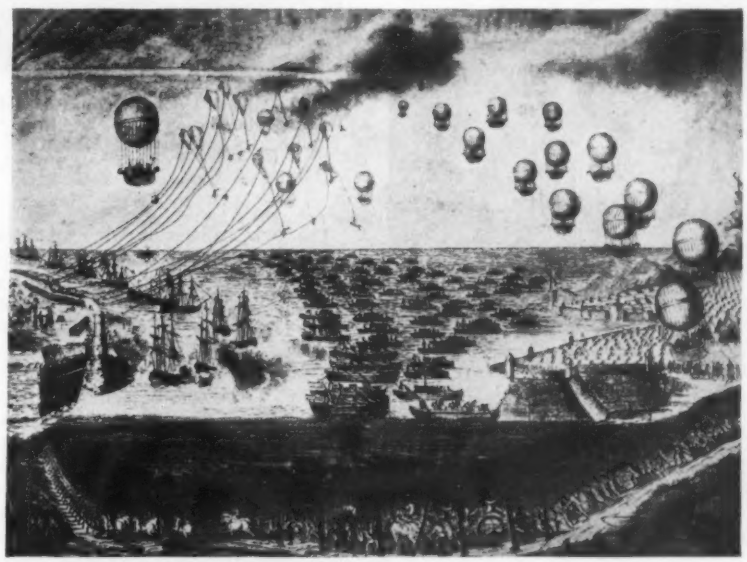


Illustration from *Horizons Unlimited,* by S. Paul Johnston. This etching, now in the Aeronautical Archives of the Institute of the Aeronautical Sciences, shows Napoleon I's plan, devised in 1809, for using balloons in an attempt to invade England.

Handbooks for Aircraft Metalworkers

The sharp increase in demand for aircraft metalworkers has attracted large numbers of new men into the trade and increased the need for handbooks and manuals simple enough for the semi-trained artisan to understand. These two books, written by the head of the aviation department of a technical high school, answer this purpose admirably. The first deals with blueprint reading. The what and why of a blueprint, how to handle it, take care of it and interpret its marginal directions are discussed. Then, by a simple method of illustrations and questions, it explains drafting conventions, detail print reading, assembly print reading, and explains limits, tolerances and drawing changes.

The second book, Airplane Sheet Metal Shop Practice, contains many of the subjects conventional textbooks neglect. The fundamentals of job operation, assembly, leaf brake bending, hand bumping, riveting, form rolling, shearing and all the allied subjects are carefully explained.

Sheet metal work such as squaring up stock, construction of webs, beam sections, angles, etc., and practical use of the theory covered, are given in the latter section of the book. In addition, subjects important to the beginner which are discussed at length include related trade information—the background information which the apprentice worker should know. Who is qualified? What is the system by which responsibility is fixed? What is the relation of the apprentice to the journeyman, to the leadman, the foreman, engineers and executives? What are the typical factory rules set up for smoother relations between the employees themselves and the plant management? What tools are required? What will his salary be? Answers to these questions are valuable to the beginner, as it keeps him from making mistakes which can cause ill will in his chosen work.

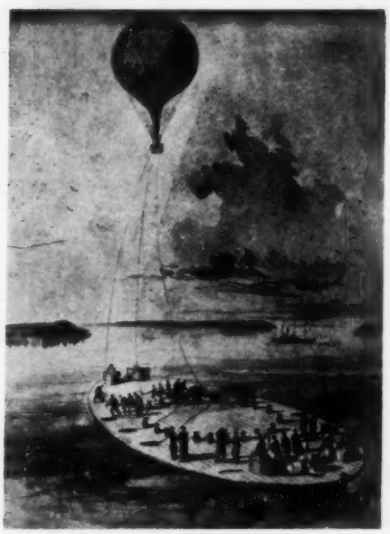
Airplane Metal Work, Volume 1: Airplane Blueprint Reading, 59 pages, $1.15. **Volume 2: Airplane Sheet Metal Shop Practice,** 109 pages, $1.25. Alex M. Robson; D. Van Nostrand Company, New York, 1940.

Aeronautics in the Civil War

The history of aeronautics in the United States has never received the comprehensive treatment that other countries have given it. England, France, Germany and Italy have exhaustive studies of the early work of their nationals in the development of the art and science of aeronautics but in the United States the field is open for such investigation.

Undoubtedly the first American book to rank with foreign definitive histories is Haydon's study of the beginning of military aeronautics in the U.S. Army. In it we find the first use of the free balloon for military observation, the first use of the telegraph for communication from balloon and the earliest primitive carrier for the launching of any air device.

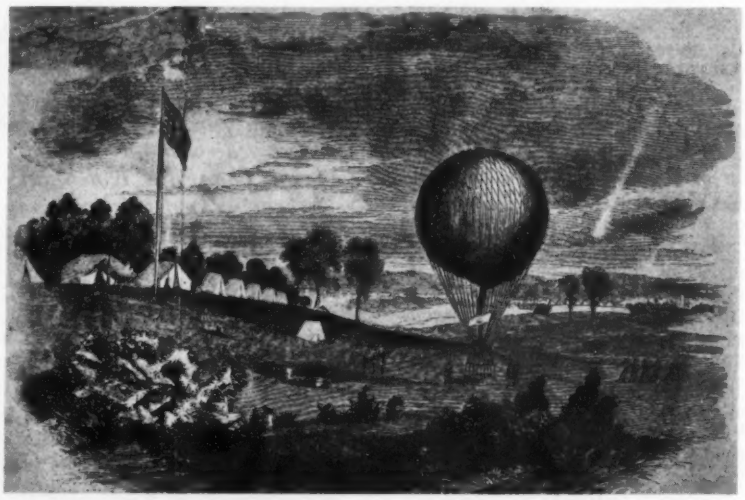
The author, with the care of a painstaking historian, has not only written a treatise on the use of aeronautics during the Civil War but has traced the beginning of military aeronautics in other countries. The documentation which is astonishing in its completeness will make the history a starting point for further investigation in other fields as well.



Balloon Boat G. W. Park Custis, the first aircraft carrier, used by T. S. C. Lowe during the Civil War.

The prints that were made of the Battle of Fleurus have perpetuated the first use of balloons in warfare better than any book could have done. Haydon has reviewed the French employment of military aeronautics with great thoroughness and lays a foundation for his subsequent American historical study.

The work of the American balloonists has never received the credit which is their due. These men aroused the interest of the public in air navigation by their daring exploits. They prepared the way for the adoption of the balloon by the military authorities as an instrument for military observation.



The Balloon *Union* at General McDowell's Headquarters, October 1861. This and the illustration (left), are from "Aeronautics in the Union and Confederate Armies," by F. Stansbury Haydon.

The four balloonists who were the pioneers with the Union Army were James Allen of Providence who made the first balloon for the Army, John Wise whose fame as an aeronaut was well established, John La Mountain the free lance Army balloonist, and lastly T. S. C. Lowe who became chief aeronaut of the Union Army and directed the operations of six balloons from 1861 to 1863. The first three of this group did not achieve the success of Lowe but La Mountain can be credited with being the first aeronaut to perform successful military balloon operations in the United States Service.

Two volumes will be required to bring the history up to 1863. This first volume carries the record only as far as the beginning of 1862, after which the balloon rendered invaluable service.

Full descriptions of the material, personnel, administration and early operations of the Aeronautic Corps are given with thousands of references to give authority to the text.

The illustrations are carefully selected and make available some material which has hitherto been buried in War Department files.

At this time, when military aeronautics is playing such a predominant role in current history, it is timely that there should appear a book which traces the origins and early achievements of American military aeronautics. A complete endorsement as to accuracy and thoroughness can be given Haydon's history. It will reflect great credit on the use the United States made of aerial observation at an early period of the development of aeronautics.

Aeronautics in the Union and Confederate Armies, by F. Stansbury Haydon; The Johns Hopkins Press, Baltimore, 1941; 466 pages, $4.00.

Welding Instructor's Manual

The increased need for aircraft welders, stimulated by defense orders, has made rapid training of new operators necessary. To aid in the instruction of these men, the Air Reduction Sales Company compiled an outline for a well planned series of exercises illustrating all the varied conditions existing in aircraft welding. This course is intended not only for new men but for operators experienced in oxyacetylene welding in other industries. Using the lectures already printed in the Airco Instruction Book, the manual outlines welding exercises in flat steel, steel tubing, aluminum and stainless steel, giving the condition of material, position, weld requirements and the method of testing for perfection in workmanship. The appendix contains special notes on characteristics of materials, preheating of metals, notes on the welding of aluminum alloys, testing equipment, specialized aircraft welding tools and other essential aircraft welding information.

Instructions in Aircraft Welding . . . Oxyacetylene, Air Reduction Sales Company, New York, 1940; 36 pages, $0.50.

POPULAR TEXTS and REFERENCE BOOKS

AIRCRAFT RADIO & ELECTRICAL EQUIPMENT
by MORGAN
384 pp. 215 illus. $4.50

AERONAUTICAL METEOROLOGY
by TAYLOR
444 pp. illus. $4.50

AERIAL PHOTOGRAMMETRY
by TALLEY
620 pp. 300 illus. $10.00

AIRCRAFT DIESELS
by WILKINSON
286 pp. 160 illus. $6.00

EXPERIMENTAL AERODYNAMICS
by PAVIAN
171 pp. 80 illus. $2.50

AIRPLANE DESIGN MANUAL
by TEICHMANN
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by WILSON
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by MARKEY
166 pp. illus. $1.50

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by BARTHOLOMEW
138 pp. illus. $1.25

Write for Complete Catalog

PITMAN
Publishing Corporation
2 W. 45th St. New York, N. Y.

History of Flying

The first edition of this book was printed in 1926 and since then revisions have been made almost yearly. The present edition is identical with the 17th through 1937. For the years 1938 and 1939 additions have been made, and events in 1940 through April have been added.

The history of flying is carried back to the hydrogen-filled soap-bubble experiments of the Italian philosopher, Tiberius Cavallo, continuing with events in lighter-than-air flying. Heavier-than-air flight is carried forward from the early glider experiments of Sir George Cayley in 1809 and 1810. Individual flights from the first crossing of the Atlantic in 1919 through April 1940, are then described in detail.

The epic achievements of famous pioneering flights are related with the care of an author who has written extensively of progress in other technical fields. It is accurate in details and presents the story of flight in a readable and interesting style.

A chronology lists important events in aeronautics from the Wright Brothers' flights through April 1940.

Heroes of the Air, by Chelsea Fraser; Thomas Y. Crowell Company, New York, 1940; 874 pages, 86 maps and frontispiece, $2.50.

A Missing Pilot's Letter

A young R.A.F. pilot was reported missing after a bombing mission over enemy territory. After his station commander determined that the young man was definitely a casualty, he went through his effects, as is the custom, before sending them home. Among these was a letter to his mother. In seven paragraphs, this young pilot summed up the spirit of the men flying in England in the present conflict. "Though I feel no premonition at all," the letter begins —"you must accept the fact that I have handed my task over to the extremely capable hands of my comrades of the Royal Air Force, as so many splendid fellows have already done." The letter goes on to thank her for the struggle she made in giving him an education, and asks her not to lose faith in the future. That his death should not be considered as a waste of her effort; rather that her sacrifice was as great as his in laying down his life. The letter is so simply and honestly written that the reader feels like an eavesdropper after completing the tiny volume.

An Airman's Letter to His Mother, E. P. Dutton & Co., New York, 1940; 15 pages, $0.50.

A PRACTICAL CURRICULUM for TRAINING SCHOOLS

ELEMENTARY AERODYNAMICS
D. C. M. HUME

Excellent elementary text on the theory of flight. Table of Contents can be used as an outline—Tests included.

126 pp. illus. $1.50

AIRCRAFT BLUEPRINT READING
ALMEN & MEAD

Contains sufficient problems and outline for a six months' class.

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PRACTICAL MATHEMATICS OF AVIATION
A. E. DOWNER

Fundamentals applied to aviation problems for all branches of the subject.

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AIRCRAFT MAINTENANCE
BRIMM & BOGGESS

Practical mechanics of the airplane handled in an expert, instructive way.

512 pp. $2.50

AIRCRAFT ENGINE MAINTENANCE
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Practical mechanics of the airplane engine. Contains complete instructions for use of tools, parts, etc.

479 pp. $2.50

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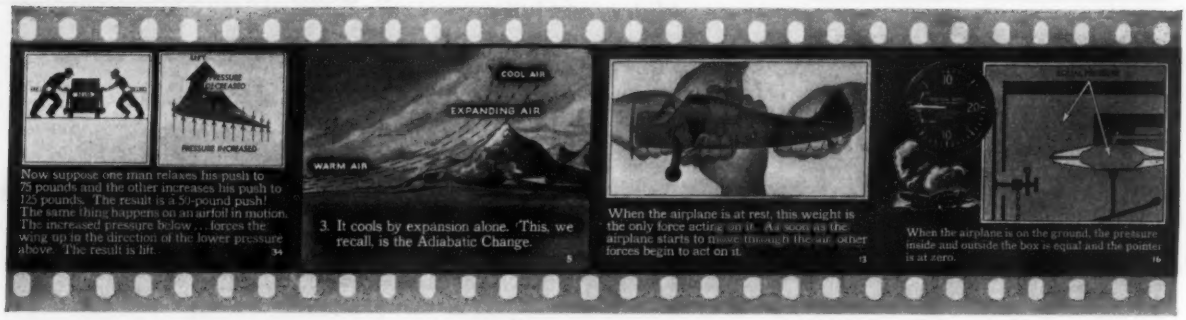

Now suppose one man relaxes his push to 75 pounds and the other increases his push to 125 pounds. The result is a 50-pound push! The same thing happens on an airfoil in motion. The increased pressure below . . . forces the wing up in the direction of the lower pressure above. The result is lift.
COOL AIR
EXPANDING AIR
WARM AIR
3. It cools by expansion alone. This, we recall, is the Adiabatic Change.
When the airplane is at rest, this weight is the only force acting on it. As soon as the airplane starts to move through the air, other forces begin to act on it.
When the airplane is on the ground, the pressure inside and outside the box is equal and the pointer is at zero.

Typical examples chosen at random from twenty-four slidefilms of the Pilot Training Course prepared by The Jam Handy Organization.

Pilot Training Course

A new visual and educational aid to pilot training, designed to accelerate the pace of ground school instruction has been made available by a large Detroit commercial motion picture organization. It consists of ground school instruction as standardized by the Civilian Pilot Training Program recorded in a carefully edited series of slidefilms.

Nearly 2,000 photographs, diagrams and drawings are used to illustrate and explain aerodynamics, meteorology, navigation, airplane structure and engines, civil air regulations, parachutes and the uses of radio. The student is shown what to do in airport and airway traffic, he is acquainted with visual and radio aids to cross-country flying, he views a simplified series of pictures and diagrams on weather in the making. Wing forces, lift and drag, balance and stability, warm and cold fronts and other intangibles over which many a ground instructor wrestles to make crystal-clear to student pilots, are shown in easily understood pictures.

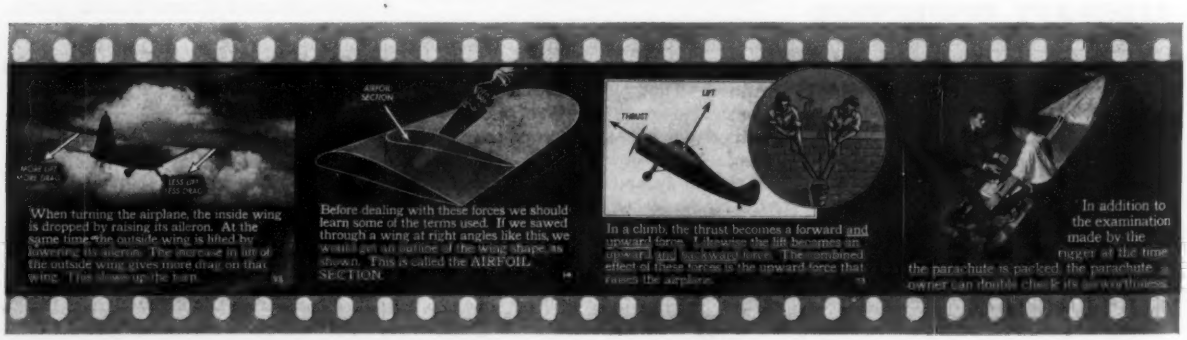
The pictures follow one another on strips of motion picture film, and are thrown on a screen by a simple, hand-operated projector. Explanatory captions accompany each picture or "frame" as it is called in slidefilm parlance, and instructors will find them invaluable both as illustrative material for lectures and as a guide to lecture sequence.

The course is made up of twenty-four slidefilms, divided into three series or kits. Kit 1 includes films on aviation history and legend, development from the World War to the present, aircraft regulation, pilot ratings and responsibility, civil air regulations, airport and airway radio traffic control. Kit 2 is made up of ten films on lift and drag, wing forces, stability, power and wing loading and loading control, checking and inspection of the aircraft, engine theory, fuel system and carburation, ignition and lubrication, engine instruments and parachutes. Kit 3 has eight films covering the air ocean, air masses, formation of fronts and pressure areas, clouds, weather maps, reports and forecasting, as well as contact flying or pilotage, dead reckoning, the compass and course plotting, airway aids, flight instruments and practical navigation problems and how to solve them.

While it will be seen that the sequence of the films in the several kits is not necessarily that of the ground school course as usually given by the C.P.T.P., there is more than enough material in the entire set to fill the number of hours allotted by the C.P.T.P. to various subjects in the private pilot course. In addition the excellent films on aircraft engines, meteorology, airway aids and traffic control will prove valuable to students in the limited commercial or secondary course of the C.P.T.P.

The films were produced under the supervision of aeronautical engineers, meteorologists, flight-instructors and pilots with a background of specialization in visual training. Research was cross-checked with authorities and the writers working on the new Government training manuals. For more than two weeks, experts of the Civilian Pilot Training Service studied and rechecked the films. After revisions the course was approved by the Civilian Pilot Training Service of the Civil Aeronautics Administration, and a copy has been placed on file at the offices of the C.A.A.

Interesting figures from tests on the effectiveness of presentation showed the following: an average group of fourteen-year-old girls made an average grade of sixty-eight on a written test, after one showing of the films. A group of adults who had not seen the films averaged only twenty-seven on the same test. In a non-college C.P.T.P. ground class an average grade of 88.29 per cent on a Civil Air Regulations test resulted from the use of the films without textbooks. The same group reviewed the films on Meteorology. On a written examination one student scored 100 per cent, the top third of the class scored over 90 per cent, the middle third over 80 per cent, and of the bottom third only four were below 70 per cent. The same test given to three re-rated instructors, actively engaged in C.P.T.P. work, who had not seen the films, resulted in scores of 80 per cent, 76 per cent and 70 per cent, respectively.


When turning the airplane, the inside wing is dropped by raising its aileron. At the same time the outside wing is lifted by lowering its aileron. The increase in lift of the outside wing gives more drag on that wing. This slows up the turn.
AIRFOIL SECTION
Before dealing with these forces we should learn some of the terms used. If we sawed through a wing at right angles like this, we would get an outline of the wing shape, as shown. This is called the AIRFOIL SECTION.
LIFT
THRUST
In a climb, the thrust becomes a forward and upward force. Likewise the lift becomes an upward and backward force. The combined effect of these forces is the upward force that raises the airplane.
In addition to the examination made by the rigger at the time the parachute is packed, the parachute owner can double check its airworthiness.

Educational slidefilms have long been used by American industry in training personnel. More recently they have been widely used—with what effect the world knows—in creating and training the German war machine. The United States Army is also beginning to use them in the training of mechanics and technicians. As one of the gravest problems in American aviation is the need for high-speed but thorough man-power training, it is believed that films of the Pilot Training Course may well suggest further and immediate development of this medium in the many fields of training for National Defense.

Pilot Training Course, produced by The Jam Handy Organization, Detroit, 1940; 24 slidefilms, 2,000 illus., $65.00 a set.

Loose-Leaf Instrument Text

The demand for textbooks made by students of instrument maintenance prompted the Kollsman Instrument Division of the Square D Company to make their handbook available to the public. For the past two years the volume was restricted to trade use and not widely publicized. Nevertheless, it has become not only the manual for Kollsman Instrument maintenance but a standard reference book on airplane instruments.

First, the general conditions for instrument repairs are described. The tools required, the manner in which workbenches should be constructed and located, the testing equipment and materials used are given. After that, general tests for failure of instruments and directions for dissecting, repairing and adjusting particular parts are outlined. Point by point, common causes of trouble in instruments, such as bent parts, broken pivots, worn gear teeth and diaphragm corrosion, are described and their remedies, whenever possible, are suggested. All of the steps in general procedure and shop practice are outlined with remarkable thoroughness.

The book then proceeds to give complete repair directions for all of the Kollsman instruments. Starting with the altimeter, the tests for accuracy in the airplane and in the shop are first outlined. Then the method of disassembling, cleaning, reassembling and adjusting both the simple and the sensitive altimeter is given, along with all the tables and other mathematical material needed for proper adjustment. The speed indicator, compass, types of engine gage units, mainfold pressure gage centrifugal, electrical and magnetic tachometer and the vertical speed indicator are treated in a similar manner.

This handbook is unusual in many ways. Most of the figures are line drawings, which illustrate the text matter with great clarity. Differing from the average handbook, this volume takes no previous knowledge for granted. All terms and processes are explained, and the text itself is presented in extremely simple language.

Handbook of Airplane Instruments, Kollsman Instrument Division, Square D Company, Elmhurst, New York, 1938; 150 pages, $2.00.

Propellers Explained

There was a time when the airplane propeller was a "prop" or a "stick," and a few simple formulas were enough to explain them to all but experts and students of propulsion. Variable pitch propellers arrived with dramatic suddenness, resulting in literature for engineers and technicians, but very little for the student pilot, the layman and the aircraft mechanic. This volume explains the aerodynamics, the theory and mathematics, the structure, maintenance and use of modern propellers in the laymen's language.

Reversing the usual order, the glossary of terms comes first, a sensible change. Thus the reader first becomes familiar with the terms the author is going to use. Then basic aerodynamics affecting all parts of the airplane are explained. This theory is then applied to the propeller, giving the mathematical formulas for propulsion in simplified form. Vibration, interference and the need for reduction gears are also explained.

The construction of wood, plastic and metal propellers is described, telling the advantages and use of each type. The operation, servicing, checking and overhaul of all types of fixed and variable pitch propellers are given, with special chapters devoted to the Curtiss Electrical, the Everel Single Blade and the Hamilton Standard controllable pitch and constant speed propellers.

The subject has been simplified so that this book may be used not only as a reference book for student pilots and laymen, but also as a textbook for secondary technical students. The illustrations by the author are clear and graphic. The explanation of the working of the Hamilton Standard strain gage was particularly commendable.

The Aircraft Propeller, by Richard Markey; Pitman Publishing Corporation, New York, 1940; 152 pages, $1.50.

Cross-Section of Air Corps Pilot Training

Many youngsters eager to enroll as flying cadets for the Army or Navy are busily asking themselves (and others less qualified to judge)—what do I have to know? How good do I have to be? How much will I have to learn? How much time will I be given to learn it? As an introductory cross-section of Air Corps curricula, Captain Leyson's book, already in its second printing, is recommended reading for all potential flying cadets. To many youngsters hesitant because of the mistaken superman aura attached to cadet requirements, we say read it once—twice—three times. It answers self-doubt with a simplicity and clarity typical of present-day Army and Navy pilot training and instruction.

It shows the candidate to what extent he will have to become a radio operator, an airplane engine mechanic, an aircraft builder, a navigator, a meteorologist and weather man, a student of aerodynamics and design, parachute jumper, airplane pilot and last, but far from least, an officer in the military or naval services of the United States. While it will be seen that the subject matter is

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Flight Training for the Army and Navy, by Captain Burr Leyson; published by E. P. Dutton & Co., Inc., New York; 283 pages, 58 illus., $2.50.

The Conception of an Airplane

There are two approaches to the preliminary design of a new airplane. One is the conservative approach, which avoids excessive optimism which might lead to fruitless research. The other is the more optimistic approach, the visionary imagination unleashed, curbed only by the fundamental limitations of physical laws and the materials available.

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Preliminary Airplane Design, by R. C. Wilson; Pitman Publishing Corporation, New York, 1941; 66 pages, $1.00.

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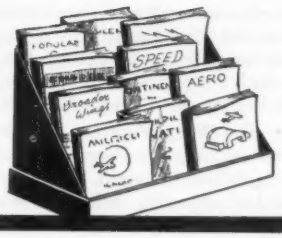

Periodicals

The reviews in these pages reflect the statements and opinions of the authors of the articles reviewed, and are not to be taken as editorial expressions of the Aeronautical Review.

Aerodynamics

Stagnation Temperature Recording. W. Wimmer. A report dealing with the development of a thermometer for recording the stagnation temperature in compressible mediums in turbulent flow to within one or two per cent error of the adiabatic temperature of the stagnation point, depending on the speed. This was accomplished by placing a thermocouple near the stagnation point of an aerodynamically beneficial body, care being taken to assure an uninterrupted supply of fresh compressed air on the junction, which, together with the use of metals of low thermal conductivity, keeps heat transfer and heat dissipation at a minimum.

The heat balance is evolved from an analysis of the conditions of similitude and a heat conductivity factor is introduced which enables approximate predictions as to accurately reading a similar body. *N.A.C.A. Technical Memorandum*, January 1941, 39 pages, 52 illus.

Progress in Aerodynamics. Vernon Outman. Developments in research are outlined on the following: drag caused by scoops, vents or other protuberances; the drag caused by surface texture of wings; slotted trailing-edge flaps; propeller cuffs; control cable deflections; tip slots and the prevention of tip stalling in large, heavily loaded airplanes. Expanded research facilities of the N.A.C.A. are also mentioned. *Mechanical Engineering*, February 1941, pages 101, 102.

Progress in Aerodynamics. Charles Tilgner, Jr. Outline of recent findings regarding high-lift devices, joining of wing and fuselage, and inboard or submerged installations of radial air-cooled engines. *Mechanical Engineering*, February 1941, page 101.

Airplane Performance Testing at Altitude. Albert C. Reed. Discussion of modern flight performance testing. The writer bases his presentation of the subject on a series of graphs showing the various performance data which must be gathered in flight tests. The reduction of flight test data to given conditions of the various factors affecting performance is also dealt with in detail, together with the technique of handling the airplane for performance tests. In the concluding paragraphs the writer states that the methods outlined apply only to the simple gear-driven supercharged engines. They do not apply to exhaust-driven superchargers. It is also stated that future use of the fluid or hydraulic drive for remote drive and for gear reduction will introduce new variables between engine and propeller speeds. *Journal of the Aeronautical Sciences*, February 1941, pages 135–150, 28 illus.

Der Schwingende Fluegel mit Aerodynamisch Ausgeglichenem Ruder (Vibrating Wing with Aerodynamically Compensated Control Surface). H. G. Kuessner and L. Schwarz. The two-dimensional problem of a vibrating wing with an aerodynamically compensated control surface is treated in the following manner: The wing is represented as a plate with articulations and steps, the wing profile as a skeleton line, consisting of one or several straight lines. Under this assumption the calculated formulas and tables may be used to calculate pressure distribution and aerodynamic reactions of vibrating control surfaces and auxiliary control surfaces, at any position of the axis of the control surface, relative to its leading edge. *Luftfahrtforschung*, December 1940, pages 337–354.

Das Zweidimensionale Problem der Beliebig Bewegten Tragflaeche, unter Berucksichtigung von Partialbewegungen der Fluessigkeit (The Two-Dimensional Problem of a Wing Which Is Moved in Any Direction, With Special Consideration of Partial Motions of the Fluid). H. G. Kuessner. The general solution of the two-dimensional linearized problem of the wing theory is converted into the special solution of a wing with harmonic vibrations by means of the Laplace transformation. For the pressure difference on the wing an integral representation may be worked out which is valid for any motion and deformation of the wing in a motionless fluid, as well as in a fluid in partial motion. Functions which appear in this integral representation are represented and tabulated by means of real integrals. *Luftfahrtforschung*, December 1940, pages 355–361.

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Berechung der Funktionen U_1 (s) und U_2 (s) Fuer Groessere Werte von s; (Calculation of the Functions U_1 (s) and U_2 (s) If the Value of s Is Not Too Small). L. Schwarz. For the functions U_1 (*s*) and U_2 (*s*) which have been defined in the preceding report, integral representations are stated which are practicable for the calculation of *s*, provided *s* is not too small. The numerical values deduced by means of these representations may be found in Tables 3 and 4. The ratio for large *s* is described by means of asymptotic developments. *Luftfahrtforschung*, December 1940, pages 362–370.

Allgemeine Tragflaechenthentheorie (General Wing Theory). H. G. Kuessner. Under the assumption of small disturbances a very general equation of the wing theory is set up which is valid for any motion, and for compressible fluids. By means of gradual specialization some simpler integral equations result, such as Possio's, Birnbaum's and Prandtl's; also some new ones for a wing of infinite length with periodic distribution of downwash, and for a vibrating wing which has a large aspect ratio. Finally some solutions and solution methods of these integral equations are stated. *Luftfahrtforschung*, December 1940, pages 370–378.

Berechnung der Druckverteiling Einer Harmonisch Sich Verformenden Tragflaeche in Ebener Stroemung (Calculation of Pressure Distribution on a Vibrating Wing in an Even Flow). L. Schwarz. A new method to calculate pressure distribution on a vibrating wing in an even flow. The solution of Birnbaum's integral equation is converted into the well-known Munk solution of Prandtl's integral equation of the layer of vorticity, and, like the latter, it may be represented in an integral form. In this way the calculation of pressure, lift and moment at a given downwash is converted into more simple integration methods, without the necessity of a harmonic analysis. *Luftfahrtforschung*, December 1940, pages 379–386.

Theorie der Schwingenden Kreisfoermigen Tragflaeche auf Potentialtheoretischer Grundlage (Theory of the Vibrating Circular Wing, Based on the Potential Theory). Th. Schade. Referring to a dissertation by W. Kinner, this report treats the problem of a circular disc which shows slight vibrations in a uniform flow. The amplitudes of these vibrations correspond to integral functions of the second degree in x and y. Pressure distribution on the vibrating circular disc is determined by means of Prandtl's potential of acceleration. This problem leads to systems of linear equations, the coefficients of which may be calculated accurately by means of exponential functions and Hankel's functions. In this analytical part all necessary equations are developed. The numerical calculation will be published at a later date. *Luftfahrtforschung*, December 1940, pages 387–400.

Bestimmung der Auftriebsverteilung fuer Beliebige Instationaere Bewegungen (Ebenes Problem) (Determination of Lift Distribution at Non-Uniform Motions) (Even Problem). Heinz Soehngen. Lift distribution on a plate of any non-uniform motion or in any non-uniform flow is determined under the conventional assumptions. Special attention is paid to arrange the definition of critical speed within the general conception of stability. *Luftfahrtforschung*, December 1940, pages 401–420.

Airplane Descriptions

How They Work: Why They Win. Descriptions of the Supermarine Spitfire and the Handley Page Hampden, with cutaway drawings, showing how each of the airplanes functions. *Illustrated.* Royal Air Force Special Number, January 1941, pages 23–25, 7 illus.

New Ryan ST-3 Low-Wing Trainer. Further descriptive data on the radial engined ST model. Construction details of the wings, ailerons, flaps, fuselage and landing gear are given in addition to the usual specifications. *Commercial Aviation*, January 1941, pages 40–42, 5 illus.

Mr. Sikorsky Made It Work. Mark Mason. Details of design and performance of the Vought-Sikorsky VS-300 helicopter. The new machine has flown up to 45 m.p.h. forward and 20 m.p.h. backward or sidewise. It can approach and hover, and one of Mr. Sikorsky's favorite demonstrations is to approach a stationary man, maneuver into position and hover while the latter drops a suitcase aboard the aircraft. Included is a discussion of the problems of control and how they were solved. *Southern Flight*, January 1941, pages 7, 16, 1 illus.

The Slip-Wing Fighter—I. Noel Pemberton-Billing. A comparison of efficiency of a slip-wing (assisted take-off) fighter with that of the slip-wing bomber as presented by the writer in the November issues of *Flight*. It is stated that assisted take-off would add little to the effectiveness of a fighter because its wing loading is only slightly less on landing than it is on the take-off. The problem of fighter speed and wing loading *versus* maneuverability is outlined, and reasons offered as to why it would always be possible to exceed fighter speed with a slip-wing bomber. *Flight*, December 19, 1940, pages 524, 525.

The Slip-Wing Fighter—II. Noel Pemberton-Billing. Description of a slipwing fighter for night patrol work. While the slip-wing principle would add little to fighter performance, the writer feels that a slip-wing fighter, which would retain the upper component while on patrol, offers many possibilities. Fighters with two hours' range require too much air field lighting at night. Fields must be lighted for take-off and landing, fighters must climb back up to patrol altitude, while fuel capacity permits very little time on actual patrol duty. The writer's idea is to let a composite slip-wing fighter do the cruising at reduced speed. The slip-wing would permit a far greater fuel capacity, in the upper component if necessary. Pilots of the upper component could be responsible for patrol, permitting the fighter pilot to rest. The slip-wing would also carry a large searchlight to assist in spotting enemy bombers. Upon sighting enemy aircraft, the fighter would cast off from the upper component and go into action with full fuel tanks, while the slip-wing might either assist with the searchlight or flares, climb out of danger, or return to base under cover of darkness. The author concludes his article with an offer to build an experimental unit at his own expense, if the Air Ministry will release the necessary materials. *Flight*, December 26, 1940, pages 550–552, 2 illus.

The Cant Z.1007bis Bomber. Details of equipment and performance of Italy's plywood bomber. It is said to be the best of Italy's bombers, with a top speed of 280 m.p.h. at 13,100 ft., and a range of 3,100 miles at 234 m.p.h. It is powered with three 14-cylinder two-row radial engines developing 1,000 hp. each. *The Aeroplane*, December 13, 1940, page 680, 5 illus.

The Savoia Marchetti S.M.79 Bomber. Description and details of Italy's standard long-range bomber. The S.M.79 is a three-engined low-wing monoplane with a top speed of 264 m.p.h. at 12,500 ft., and a maximum range of 1,615 miles at 224 m.p.h. Wings are wood, with stressed plywood covering, fuselage welded steel tubing with fabric covering, and it is powered by three 750 hp. Alfa-Romeo engines. Other data on performance and armament is given. *The Aeroplane*, December 20, 1940, page 704, 5 illus.

Air-Inflated Metal Wing Supports Four-Wheel Flivver Plane. Brief

description of a light stainless-steel airplane designed by William B. Stout. In appearance it resembles the earlier Stout "sky-car." *Popular Science*, March 1941, page 80, 3 illus.

The Rearwin Ranger. A description of the two-place, 75 hp. Continental-engined Rearwin Ranger monoplane. This article also gives an account of a demonstration flight in the craft. A complete critique of the airplane, its interior, its flying and taxiing characteristics, its visibility on the ground and in the air is included in the report. *Air Facts*, January 1941, pages 12–18, 2 illus.

The Breda 88 Fighter-Bomber. The Breda 88 is said to be the fastest Italian military airplane in service at the present. Powered with two 1,000 hp. radial engines, it has a top speed of 326 m.p.h. with full military load. Used as a fighter and light bomber, the Breda 88 is a two-place, high-wing monoplane of all-metal stressed-skin construction. Armament consists of two 20 mm. cannon and two .50 caliber machine guns mounted in the nose and a large caliber machine gun firing to the rear. Dimensions and specifications are given. *The Aeroplane*, January 3, 1941, page 14, 5 illus.

American Commentary. "Indicator." The advantages and drawbacks of several types of American airplanes purchased by the Royal Air Force are discussed in this comparison between British and American types. The Lockheed Hudson, the Douglas DB-7 and the Martin bombers have, according to this critic, many favorable characteristics. The Curtiss P-40 and the Boeing "Flying Fortresses" are indicated to be seriously underarmed. It is stated that the Spitfire and Hurricane, The Wellington, Whitley and Hampden, designed years ago, are still years ahead of anything being produced in the United States at the moment. The North American Harvard advanced trainer is rated as being admirably suited for this particular type of work. *Flight*, January 9, 1941, pages 31, 32, 2 illus.

Fletcher Basic Trainer. This two-place basic trainer, powered by a Wright Whirlwind R-760-El 285 hp. engine is unique in structure, applying an all-plywood stressed-skin method of construction. The ribs and spars as well as the fuselage bulkheads and stringers are of spruce, while the stressed-skin covering is two-ply resinous-bonded birch called Plasti-Ply, bonded together by the Plyweld process, developed by the Fletcher brothers, designers and builders of the airplane. *Aero Digest*, February 1941, pages 165, 166, 4 illus.

The Savoia Marchetti S.M.85 Dive Bomber. A twin-engined, single-place dive bomber, the S.M.85 is of all-wood construction, and is powered with two 1,000 hp. radial engines. Maximum speed is said to be 317 m.p.h. at 13,100 ft. Other performance details and specifications are given. *The Aeroplane*, December 27, 1940, page 740, 5 illus.

British Aircraft Reviewed. Descriptions of forty types of aircraft now being built in England by twenty companies, indicating the difficulties being encountered in the effort to standardize production. Airplanes built by the following companies are described: Airspeed, Armstrong-Whitworth, Avro, Blackburn, Boulton-Paul, Bristol, de Havilland, Fairey, General Aircraft, Gloster, Handley-Page, Hawker, Parnall, Phillips and Powis, Percival, Saro, Short, Supermarine, Vickers, and Westland. *Flight*, December 12, 1940, pages 498, a–j, 499, 34 illus.

A Light Trainer From the U.S. Details and specifications of the Howard DGA-125 trainer. *Aeronautics*, January 1941, page 42, 2 illus.

From Cygnet to Owlet. R. H. Rogers. Another detailed description of the Owlet day or night trainer manufactured by General Aircraft Ltd., makers of the popular British light airplane known as the Cygnet. The Owlet is a tandem two-place machine, powered by a Cirrus Major engine of 150 hp. It has a cruising speed of 110 m.p.h. and a landing speed with flaps down of 53 m.p.h. Range 450 miles. Features include the Cygnet-type twin rudders and tricycle landing gear. *Aeronautics*, January 1941, pages 46–49, 5 illus.

The Sportsman Test Pilot. James B. Taylor, Jr. Description of the Aeronca Super Chief and the Aeronca Trainer. Interior appointments of the Super Chief are described together with its ground and air handling characteristics. Some difficulty in judging the latter with both airplanes was encountered because of the control stiffness of new equipment. *The Sportsman Pilot*, January 15, 1941, pages 14, 15, 47, 4 illus.

They Make Their Bow. Description and details of the 1941 Duotone de luxe Taylorcraft and the Ryan St-3. *The Sportsman Pilot*, January 15, 1941, pages 24, 25, 28, 6 illus.

Aviation's All American Air Show-in-Print. Specifications, performance figures, notes on construction and materials, and standard equipment of civil and military aircraft built in the United States. Included are three-view drawings, and a photograph. *Aviation*, February 1941, pages 52–78, 81, 84, 86, 90, 93–95, 93 illus.

The Fiat G.50 Single-Seat Fighter. Said to have been designed in a hurry for the Spanish war, the G.50 powered by an 840 hp. two-row radial engine has a top speed of 299 m.p.h. at 14,760 ft. Armament consists of two .50 caliber machine guns firing through the propeller, and it is designed to carry 144 1-kg. bombs in the fuselage. Other details of dimensions and performance are included. *The Aeroplane*, January 10, 1941, page 40, 5 illus.

Das Amphibium-Segelflugzeug "Jacht 71" (The Amphibian Glider "Jacht 71"). This is a new type of glider developed by S. F. Jachtmann, which is able to take-off from land and from water. The starting device which seems to be the principal part of this development is the Jachtmann winch (a rear wheel of an automobile converted into a winch, driven by an engine). During tests this glider took-off after a surprisingly short tow of from 8 to 10 meters. *Der Deutsche Sportflieger*, November 1940, page 230.

Junkers Ju87 ("Stuka"). The problem before the designer was to create an airplane which would be a first class dive bomber, but which at the same time would be maneuverable and fast during horizontal flight. In order to make the Stukas—the "Flying Artillery"—effective, the absolute aim at diving had to be perfected as much as possible. As at diving speeds of 150 meters per sec. (540 km. per hr.) the time is very limited and as the pull-out curve has to be very wide in order to avoid excessive loads on man and machine, the diving process on the Ju87 has been made automatic to a large degree. The number of manual control operations during diving has been reduced as much as possible by either making them automatic or by combining them, so that the pilot may concentrate on his target. An important means of decreasing diving speed is the air brake which creates additional resistance on the wing. The characteristic inverted gull wing of the Ju87 was adapted in order to get a lower landing gear, better visibility, and an aerodynamically fine transition between wing and fuselage. This bomber is of a very strong construction, able to withstand severe hits, and is especially adapted for rough service. *Schweizer Aero-Revue*, November 1940, page 348.

Angaben ueber die Festigkeit des Jagdflugzeuges Messerschmitt Me-109 (Strength Characteristics of the Messerchmitt Me109 Pursuit Plane). According to wind tunnel tests and to test flights the strength of this airplane ranges into the highest stress

group (5) of the German construction specifications. This means that during pull-out of a dive it has to withstand a safe-load factor of 6 without damage, *i.e.*, six times the load of normal non-accelerated flight in the corresponding flight attitude. In upside-down flight the load factor is 3. A safety factor of 1.8 (for important connections 2.07) is multiplied with the above loads, in order to get the proper breaking load. There is therefore a safe-load factor of: $6 \times 1.8 = 10.8$. The wing is calculated for a maximum dynamic pressure which corresponds to a speed of 800 km. per hr. at sea level; this speed has been determined during dive tests from various altitudes, whereby variation in resistance when approaching the speed of sound as well as resistance of the propeller have been taken into consideration. The slot has been especially examined in the case of stalling during pull-out when the heaviest loads are created. In accordance with experience during flight, vibration tests proved that this airplane may be considered to be vibration-proof at all speeds. *Schweizer Aero-Revue*, November 1940, pages 347, 348.

Air Policy

The Case for the Airship Today. Commander C. E. Rosendahl, U.S.N. An authoritative analysis of the tactical value and functions of rigid and non-rigid dirigibles. Emphasizing the fact that nearly all the world's supply of helium is found in the United States, the writer urges an expanded program of airship development and construction. For low-speed, long-range coastal patrol work he points out the many advantages of the non-rigid airship or blimp, stressing the fact that its low speed enables it to do a more efficient job of spotting mines and submarines. Their ability to locate and hover over submarines is said to be the reason that during the last war, no convoy escorted by airships was successfully attacked by submarines. Blimps were used also for locating and marking mines. On one occasion in the last war, a single airship sighted and marked 368 mines in one flight.

For long-range ocean patrol duty, Commander Rosendahl believes that the large rigid airship deserves the most thorough consideration. Carrying its own scouting airplanes, it can cruise for days at a time and cover vast areas. He also suggests that a 10,000,000 cubic foot airship would make an aircraft carrier of no mean striking power. It could carry ten attack-bombers and cruise nonstop for 10,000 miles. By launching bombers in mid-air it could thus serve as a base for high-speed heavily loaded bombing aircraft whose take-off and landing speeds would not permit them to operate from surface carriers. Airship vulnerability is said to have been lessened by helium, by its own defensive airplanes, and by the superior defensive fire power which could be carried. Its chief defense like that of the surface carrier would be to avoid danger zones by use of its scouting airplanes. In conclusion Commander Rosendahl quotes from a British editorial in *Flight*, in which the value of airships for patroling England's trade routes, is pointed out. The author also stresses the saving in time and cost which would be effected by using airships instead of cruisers to locate sea raiders, such as the *Emden* or *Admiral Scheer*. *Preprint from a paper by Commander C. E. Rosendahl, U.S.N.*

Consolidated Delivers "Battle Cry." Message to employees by R. H. Fleet in which he points out that material assembly, tools and fixtures, and the fabrication of a large airplane takes two years. With cost no object, he believes that the minimum time required is eighteen months, with everyone concerned working at top speed. Bearing in mind that the Germans had a five or six year head start, he urges full speed ahead. *Commercial Aviation*, January 1941, page 60, 1 illus.

Civil Aviation's Role in Defense Mobilization. C. B. Allen. It is stated that officers of the Air Corps in charge of pilot training believe that the present rate of expansion in their training program would not have been possible without the utilization of established civilian flying schools for the primary stage of Army training. The writer quotes Brig. Gen. John B. Brooks, commanding the Gulf Coast Air Corps Training Center, who stated, "The quality of the trainees sent us by our contract training schools throughout the country exceeds the Army's fondest expectations." Mention is also made of the Army's air infantry training program at Ft. Sam Houston, Texas, which entails flying an entire regiment complete with equipment, to any danger zone. Ninty-two per cent of such a force and equipment would be flown in standard transport airplanes. *Western Flying*, January 1941, page 13, 1 illus.

Aircraft Production and Engine Problems. Col. G. de Freest Larner. The writer believes that the necessity for increased speed in aircraft deliveries has produced too much "near-expert" and un-expert opinion on the subject. It is shown that pressure exerted by mis-informed opinion can handicap the efforts of authoritative aircraft experts, thus placing the United States in a position similar to that of France before the invasion.

It is also pointed out that if the United States builds 25,000 airplanes for the Army Air Corps and half that number for the Navy, the 2,200 airports existing today, even if improved, would be able to accommodate only half this number to the total grounding of all other aircraft.

The production of the Rolls Royce Merlin engine in the United States, which, up to recently was considered as a method of bolstering liquid-cooled production, is said to be wasteful, as it would result in the building of an already obsolete engine, eighteen months hence. If engines of a foreign design are to be produced, 2,000 hp. Rolls Royce and Napier power plants of the latest type are suggested.

Recent research is cited to refute the contention that head resistance of the two-thousand-hp. two-row radial engines manufactured in the U.S. necessarily restrict top speed performance. The necessity of maintaining airlines as an adjunct to national defense is also shown. *Aero Digest*, February 1941, pages 42, 154.

Is Our Hemisphere Safe from Invasion? Heraclio Alfaro. The belief that the Western Hemisphere is safe from invasion as long as England controls the Atlantic is discounted by this writer. The fact that Germany has, for some time, operated an air line across the South Atlantic is offered as evidence that they can, with the proper equipment, transport troops for an invasion of the Latin Americas. This danger is aggravated by the lack of modern arms in the possession of these nations, and by the absence of centralized military command. The United States, according to this writer, can serve defense better by constructing long range bombers than by building battleships. Comparisons on the defensive usefulness per dollar spent between bombers and battleships are given. The vulnerability of U.S. interests in the Philippines and the Far East is also discussed. *Aero Digest*, February 1941, pages 52, 54, 56, 2 illus.

Speed—The New Factor. Captain Norman Macmillan. The writer expresses concern lest the demands of the Army and Navy weaken the effectiveness of the R.A.F. Bomber Command in action against Germany. He again urges independent action against German objectives by the R.A.F. and questions the wisdom of assigning the Coastal Command to convoy duty at the expense of lessen-

ing their raids on channel ports. *Flight*, January 2, 1941, pages 6–8.

Lord Beaverbrook and Output. Report of a radio address by the British Minister of Aircraft Production, in which he states that by 1942 the famous 3,000-a-month scheme of aircraft procurement in the United States will finally be realized. While Lord Beaverbrook stated that the performance and speed of the Curtiss P-40 or Tomahawk, as it is called by the British, is equivalent to the Spitfire, his statement is disputed by the editors of *The Aeroplane* on the preceding page.

Aircraft production in England is reviewed briefly and the men and women in aircraft plants who have increased production despite bombing attacks are given wholehearted praise for the job they have done. Lord Beaverbrook also said that airplanes are ready for every available pilot. *The Aeroplane*, December 27, 1940, pages 424, 425, 1 illus.

Help in Good Time. British editorial reaction to the American proposal to lend or give war supplies to Great Britain. It is stated that the nobility of that proposal matches the greatness of British endurance under the Nazi offensive. The need for quick aid is outlined, and the last speech of Lord Lothian quoted to the effect that in backing Great Britain, the United States will not be backing a quitter. *The Aeroplane*, December 27, 1940, pages 721, 722.

Federal and State Jurisdiction over Civil Aviation. Oswald Ryan. A discussion of the Civil Aeronautics Act, and the problem of determining the respective fields of Federal and State jurisdiction over civil aviation. A plea is made for the prevention of a dual system of inconsistent and conflicting regulation such as marked the long conflict between the federal and state governments, in regulating public utilities and rail transportation. *Journal of Air Law and Commerce*, January 1941, pages 25–32.

Production for Defense. William S. Knudsen. Report on the work of the Production Division of the National Defense Advisory Commission. Mr. Knudsen explains why certain policies were adopted, and voices the hope that by late spring or early summer first production results from the present program will begin to show. The plant amortization plan is discussed together with the need for speed and a plea that engineers, machine manufacturers, and builders give as much of their time to defense problems as they can without impairing health. The production status of airplanes, guns, tanks, small arms, explosives, and machine tools is outlined, together with a brief analysis of labor laws and strikes in defense industries. The problem of price increases is discussed, and in conclusion he stresses the fact that "this is an all-for-one show," and issues a challenge with the homely suggestion "so let us go to it and get the stuff out!" *Army Ordnance*, January-February, 1941, pages 333–335.

Many Wings in the Air.—C.A.A.-C.A.B. Review. Official summary and figures on C.P.T.P. and aviation in general. A glance at the figures shows that of 25,168 youngsters who received C.P.T.P. pilot certificates more than 10 per cent have been accepted as flying cadets. C.P.T.P. washouts ran between 12 and 13 per cent. Refresher courses were given to 1,280 commercial pilots, and to 3,943 flying instructors. Other data are given on civil aircraft production and increases in the number of airports and flying fields. *The Sportsman Pilot*, January 15, 1941, pages 22, 23, 7 illus.

Airports and National Defense. A. B. McMullen. Outline of a program by which 4,000 airports and landing fields needed in the United States and its possessions, for purposes of national defense, would be built in the next few years. It is stated that thus far $40,000,000 is being spent to begin the work, which it is estimated will cost $558,000,000 exclusive of land, buildings and upkeep. The need for underground, bomb-proof hangar facilities is also discussed together with the necessity for bringing to the attention of the American people the importance and urgency of this problem. *Journal of Air Law and Commerce*, January 1941, pages 51–57.

Aerial Observations—C.P.T.P. Appropriation. Summary of accomplishment of the C.P.T.P., offered to support a continuance of the program with an adequate appropriation for next year. (Ed. note: The 1941–42 appropriation has been cut to less than half of the present budget.) It is stated that the C.P.T.P. will have trained 45,000 pilots between June 30, 1940 and June 30, 1941; has brought 4,000 instructors up to present-day standards; has developed 700 approved government training centers; has made a safety record which has brought down insurance rates from $35 to $9 for the same covering policy; has supplied the Air Services with 2,636 cadets whose records indicate thus far that they may average 50 per cent fewer washouts. The latter represents a considerable saving, as it costs in the neighborhood of $20,000 to train a cadet at Randolph and Kelly fields. The effect that cutting the program will have on operators and the industry as a whole is also discussed. *The Sportsman Pilot*, January 15, 1941, pages 7–9, 2 illus.

Guns Aren't Windshield Wipers. Charles F. Kettering. The problem of mass production is explained and compared to the publication of a book or magazine. It is shown that the time required for design, development, tooling, and preparing for a mass production run, is very like the writing, editing, proof-reading and make-up that must be done before the presses and binders can turn out the finished publication. This discussion is a reply to the average man's assumption that because industry can mass-produce cars, trucks, and peacetime products in lots of thousands per day, it can turn out airplanes, tanks, guns and ships, at a moment's notice, the same way. *Saturday Evening Post*, January 18, 1941, pages 12, 13, 72, 73, 76, 2 illus.

Engineers Against Time. Discussion of the need for an accelerated interchange of ideas between engineers. It is pointed out that now as never before, American engineers are in a race against time. New developments are taking place with extreme rapidity. The need for new data, new information, and more discussion keeps pace with new demands on time and production facilities. The importance of aeronautical research is emphasized, together with the need for planning for post-war adjustments. *Mechanical Engineering*, February 1941, pages 93, 94.

Let's Defend What We Have! James Bassett, Jr. Analysis of the vulnerability of our West Coast to invasion, either from Mexico or Alaska. It is stated that due to the exposed condition of electric lines and the huge water supply lines running across the desert to Los Angeles, successful bombing attacks would cut off water and electricity from the Los Angeles area. In test war game "invasions" it has been proved that the Southern California area is dangerously under-manned, under-equipped, and lacks any natural barriers to invasion. Years ago military strategy called for abandoning the entire area, but with the development of its oil fields, and more recently of its billion dollar aircraft manufacturing industry, it is stated that all out preparations should be made at once for its defense. *Flying and Popular Aviation*, February 1941, pages 24–26, 60, 64, 88, 89, 7 illus.

War's Progress. Discussion of present status in aircraft production, the establishment of O.P.M. (Office of Production Manager) by the Defense

Commission, and the appointment of T. P. Wright as Associate Director of Aircraft Production. *Aviation*, February 1941, pages 48, 49, 4 illus.

Airports

Airport Traffic. William D. Strohmeier. In order to simplify ground traffic at airports, the writer suggests that a universal rule of right-hand turns only while taxiing be established. The article furnishes proof that this practice would not, as many pilots might argue, make for congestion on the ground, but would simplify airport traffic and increase safety on the runways. *Air Facts*, January 1941 pages 19–21.

Assisted and Restricted. "Indicator" Landing and take-off characteristics of military aircraft and particular operating conditions dictate the surfacing of airports. This article is a comparison between grass covered fields and concrete runways, indicating the advantages and disadvantages of each. The ground requirements of tricycle undercarriages and assisted take-off devices are also discussed. *Flight*, December 12, 1940, page 500.

Aerodromes for War Flying. L. T. H. Greig. A plea that many of the military airfields in England which have recently been built, be retained after the war to provide a more extensive system of airports, for civilian flying in times of peace. It is also suggested that radio beacons and traffic control tower radio equipment be installed as part of a future program of improvement of civil airports. *Aeronautics*, January 1941, page 71.

Airline Airport Capacities. Reed G. Landis. A discussion of airport capacities from the standpoint of service to the community, economic stability, and traffic accommodation. Sources of revenue are analyzed and suggestions offered for determining the requirements of airline terminal facilities. *Journal of Air Law and Commerce*, January 1941, pages 58–63.

Big Base. E. D. James. Account of the expansion of the Milwaukee County Airport. Shortest runway is 3,700 ft.; the longest is just under a mile. How this expansion program was sold to the business men of Milwaukee, is told in detail. *Flying and Popular Aviation*, February 1941, pages 21, 70, 89, 1 illus.

Passenger Haven. Donald O. Herty. Description of the facilities and services of the Airlines Terminal in New York. *Flying and Popular Aviation*, February 1941, pages 39, 40, 76, 77, 78, 3 illus.

Air Transport

"Lodestars" Come to Canada. Six 14-passenger Lockheed Lodestars have been delivered to Trans-Canada Air Lines from the Lockheed Aircraft Corporation. A description of the new transports and what they will mean to T.C.A. in increased speed and improved service, is given. *Commercial Aviation*, January 1941, pages 34, 35. 4 illus.

Boeing Clippers Refitted for Longer Range. The increased demand on passenger and mail space aboard the Pan American Airways Transatlantic Clippers prompted the complete refitting of the flying boats in order to save weight and increase range. This was accomplished by stripping the Clippers of many of the weight consuming luxuries and decorations which the airplanes had been carrying up to this time. The substitution of lanolin for the regular paint on the exterior, the removal of berths, the simplification of the steward's department and other weight savings which resulted in increased payload and permitted the elimination of the Azores stop, as well as engine and propeller changes which improved the Clippers' performance are described. *Aero Digest*, February 1941, pages 72, 158, 4 illus.

Sun-Racers and Sky-Chiefs. Griffith Brewer, President of the Royal Aeronautical Society. Description of a trip over Lake Mead, Boulder Dam and the Grand Canyon in a Boeing Stratoliner. The flight was part of a 5,000 mile round-trip by air to the West Coast and return. The writer describes the spaciousness of the 4-engined Boeing, and his interest in discovering that the initials R.N. after the name of the Hostess on duty meant Registered Nurse, and not Royal Navy. In the second half of the article, speaking as an aeronautical engineer, the writer suggests that speed and range of the Stratoliner could be increased at a slight decrease in luxury, by lessening the diameter of the cabin. He also expressed surprise at the fact that air pressure in the cabin is not turned on until an altitude of 8,000 feet is reached, instead of pressurizing gradually from the take-off. *Flight*, January 2, 1941, pages f-9, 3 illus.

Flight 54. Robert N. Buck. A TWA captain's account of a routine flight from Pittsburgh to New York, explaining the manner in which meteorological data is received, interpreted and applied by the airline's flying personnel. *Air Facts*, January 1941, pages 8–10, 46.

Horses, Bulls, Tractors Take Wing in Big Air Freighting Contract. Sidney J. Woodham. An account of an air freight transport operation, by which all materials are being flown to the scene of a war construction project in Northern Quebec. Site of the construction can be reached only by air transport, and up to November 1, 494 passengers and 626 tons of freight had been carried to the construction camp. Facilities, equipment and problems involving the transport of livestock and heavy freight, are described. *Canadian Aviation*, January 1941, pages 23–25, 8 illus.

Beaver Bonanza on Wings. John F. Coggswell. Fur trading is being done by airplane in Northern Maine this winter. After a successful start last season, Clarence Sproul operates four airplanes and services upwards of fifty trappers. Sproul collects the furs and flies them to market to take advantage of sudden rises in market prices. The article also describes a pilot-trapper team which hunts beaver ponds by airplane. Running their trap lines by airplane enables them to cover a wide territory, and to concentrate on beaver. It is stated that the fur market came back to life during the winter of 1939–40, and higher prices resulting from wartime shortage of imports has brought trappers and pilots together. *Saturday Evening Post*, January 11, 1941, pages 16, 17, 52, 57, 6 illus.

The Contemporary Air Transport Picture. Captain E. V. Rickenbacker. A survey by the president of Eastern Air Lines of the progress that the air transport industry has made, technically and commercially since passenger service began in 1926. The writer points out that the airlines have brought the trade centers of South America days and sometimes weeks closer to the United States. Future improvements in comfort and safety are forecast for the industry which, through air mail and feeder systems, is serving increasing numbers of American communities. The article also includes a survey of the present equipment and service of Eastern Air Lines and reveals increases in equipment which are to be added soon. *National Aeronautics*, January 1941, pages 12, 13, 3 illus.

The Trend of Air Transportation. Edmund T. Allen. An analysis of the development and growth of air transportation. By charting trends in passenger and ton miles flown together with increased speeds, range and load of air transports, the writer supports his belief that air transport is in the transition stage between the pioneering period and that of mature growth. *Transactions of the A.S.M.E.*, January 1941, pages 1–11, 14 illus.

Wings Up the River. Mervin Rosenbush. Two veteran Mississippi River steamboat men are now using two airplanes for survey work and trouble shooting in connection with their tugboat barge line operation. They began flying for pleasure, but soon found that the "scouting" possibilities of an airplane over a river whose channel is constantly shifting, made it worth while to buy an airplane for business use. They now operate two Edo equipped Luscombes. The latest is said to have a two-way radio, operating on the wave length of the ship-to-shore system of their barge fleet. *Flying and Popular Aviation*, February 1941, pages 27, 28, 4 illus.

Armament

Tactical Aspect of Flexible Aircraft Cannon. Kent Sagendorph. A description of the flexibly mounted 37 mm. aircraft cannon and an explanation of its uses in defending a bomber from attack by fighter aircraft. Some specifications of this 37 mm. gun, manufactured in the United States, are also given. *U.S. Air Services*, January 1941, pages 14, 15, 2 illus

Antitank and Antiaircraft Guns. Brig. Gen. R. H. Somers. Discussion of trends in the use of intermediate artillery. Modern antiaircraft guns and their range-finding equipment, are described, together with the use of heavy machine guns and quick-firing 37 mm. and 20 mm. cannon firing tracer ammunition against low flying aircraft. *Army Ordnance*, January-February 1941, pages 345, 346.

Biography

"Just Call Me C. R." Jack Alexander. Biographical sketch and career story of C. R. Smith, president of American Airlines. Smith, since becoming president, has flown constantly on trips of inspection and trouble-shooting. The result has been a decided improvement in management, service and business for the line. Born and raised in Texas, "C. R." became the man of the family at the age of nine. He began as office boy for a famous Texas cattle man, put himself through college, and after various experiences found himself managing a small airline which became Southern Air Transport, and later became part of American Airways (now American Airlines). As manager of the Southern Division he did so well on cutting overhead and eradicating office politics, that later, when cancellation of mail contracts caused a crisis in the affairs of the company, he was made president. Many of the improvements for which he has been responsible are described. *Saturday Evening Post*, February 1, 1941, pages 9–11, 69, 70, 72, 5 illus.

Hospitality Plus. Helene Maddux Walling. Career outline of Doug Kelley, San Diego's host to the sportsman pilot. President and general manager of Airtech, he began as a flying cadet and graduated from Kelly Field in 1926. Later he was chief pilot for the Ryan Flying School, and in 1928 joined San Diego Air Service, which was changed to Airtech Flying Service in 1932. More recently he served as co-pilot on the Guba on a non-stop cross-country trip from San Diego to Port Washington, for delivery to the British. Other experiences as a charter operator are described. *Western Flying*, January 1941, pages 24, 25, 3 illus.

Richard W. Millar. One page biography of the president and general manager of Vultee Aircraft, Inc. *Western Flying*, January 1941, page 17, 1 illus.

Here's My Story—The Career of Major A. W. Stevens. Picture and caption treatment of the career of a U.S. Army officer who made several balloon ascensions to the stratosphere. *Popular Science*, March 1941, pages 100, 101, 11 illus.

Col. Clarence Marshall Young. A biography of Clarence M. Young, Pacific Division Manager of Pan American Airways, former Assistant Secretary of Commerce for Aeronautics. *U.S. Air Services*, January 1941, pages 26, 28.

Pop Musick—2,000,000 Miler. George Mason. A biography of Captain Harry T. Musick, veteran pilot of Pennsylvania-Central Airlines, whose career of nearly 15,000 flying hours does not include any hair raising events. The article also outlines the Captain's philosophy, his character and his hobbies. *National Aeronautics*, January 1941, pages 8, 9, 3 illus.

Air Chief Marshal Sir Hugh Dowding. One page biographical sketch of "Stuffy" Dowding who until recently has commanded the R.A.F. Fighter Command. Leader of the two great air victories—those of August and September when the R.A.F. Fighter Command turned back the German mass attacks, Sir Hugh Dowding is to be sent by Lord Beaverbrook to the United States where his technical and practical experience will be made available to American designers and manufacturers. *Aeronautics*, January 1941, page 38, 1 illus.

Pilot with an Idea. Edward Churchill. Steele's Aid to Pilots has simplified the Civil Air Regulations for thousands of pilots. Compiled by Earl Steele, a pilot with 9,000 hours to his credit, the handbook developed from an effort to translate the Regulations for a friend. The writer outlines Mr. Steele's career in aviation and describes his pilot handbook. *Flying and Popular Aviation*, February 1941, pages 29, 68, 88, 2 illus.

Business and Finance

Union for Operators. Selby Calkins. Introduction to the newly-formed National Aviation Training Association. The need for the organization and its announced policies are discussed, and names of its officers, as well as those of the delegates to the organizing convention at Kansas City, are listed. *Western Flying*, January 1941, pages 18, 19, 30, 5 illus.

Westerners Sell Airplanes! Carl Elkins. Outline of the sales activities and standings of some of Taylorcraft's leading distributors. *Western Flying*, January 1941, pages 22, 23, 3 illus.

Aviation Invades Detroit. Robert S. Ball. Outline of the program of sub-assembly and aircraft engine building being undertaken by the Detroit Automobile Industry. Schedules for the near future include Packard production of the Rolls-Royce Merlin engine, Ford production of the Pratt & Whitney Twin-Row Wasp engine, as well as parts and sub-assemblies for 24,000 Martin, North American and Consolidated bombers for Great Britain and the United States. New engine production and development is also under way at Chrysler, Continental and Ford, while Allison production is showing a sharp rise. Preparations at Briggs, Murray, and Fisher, to supply sub-assemblies for Douglas Aircraft, are also mentioned. *Flying & Popular Aviation*, February 1941, pages 30, 31, 72, 74, 3 illus.

Design

Airliner—1960. George H. Tweney. Description of probable shapes, sizes, weights, and performance of large flying boats of the near future. It is stated that the Glenn L. Martin plant has begun construction on a 62½ ton flying boat for the Navy, and that a hundred-ton craft is on the drawing boards of the Consolidated Aircraft Corporation. Also mentioned is a statement by Dr. Schuyler Kleinhans, chief flying boat designer for the Douglas Aircraft Corporation, that given $20,000,000, a trained staff, and three years, it would be possible to build a 1,500 ton flying boat that would carry 600 people. Interior designs and construction materials are also discussed. *Western Flying*, January 1941, pages 14–16, 6 illus.

Undercarriages. R. Hadekel. Discussion of modern landing gear equipment. Problems of design are outlined under the following heads: general layout and stability; absorption of landing impact and comfort during taxiing; detail design; retraction. The need for simplicity of design as well as reliability and low cost, is emphasized throughout the paper. *The Aeroplane*, January 3, 1941, pages 23–26, 7 illus.

Flotation of Aeroplanes. J. A. Medhurst. Presentation of the buoyancy model method of obtaining flotation attitude and waterline. *Flight*, December 26, 1940, page 553.

Some Aspects and Possibilities of Flying Boat Design. Dr. Michael Watter. A discussion of the future of long range flying boat design which indicates that the aerodynamic disparity in present day flying boats and landplanes is an outcome of trends and not necessarily basic differences between the two types. The article outlines many of the problems of flying boat hull design, such as deciding between sponsons or auxiliary floats, placing of the step and contouring the bottom. The special considerations required by military seaplanes are also discussed. The writer concludes that, although the present-day landplane is aerodynamically superior to existing flying boats, the latter afford greater payload with equal range or the same payload with a greater range. He also states that aerodynamic inferiority is due to mechanical complications and that aerodynamically clean flying boats can be made a practical reality. *Aero Digest*, February 1941, pages 125, 126, 129, 130, 133, 4 illus.

Looking Ahead. Sydney Camm. The designer of the Hawker Hurricane discusses the immediate future of military aircraft construction. Examining materials, the writer states that, due to the large cross-sectional area required for wood structure, which would cramp storage space, this material was unsuitable for fighter production. Other disadvantages are also indicated. The tendency, according to the writer, is toward the exclusive use of light alloys. Of the many systems of aircraft construction, three have survived, namely fabric covered braced structure, stressed skin, and the geodetic system. Owing to limited stowage available in most fighter craft, combinations of the systems are frequently used. In discussing general design, the writer points out that while there is tendency toward the building of basic types, production must not be "frozen" to the extent that changes for alternate duties cannot be made. Performance, of course, must be improved. Despite the improvements in streamlining the engine nacelles of twin-engined aircraft, the increased drag has discouraged this type of design. Internal stowage of two engines, delivering power by driveshafts to counter-rotating propellers is forecast as a fighter design of the future. *Flight*, December 12, 1941, pages 491–493.

Design for Climb. W. O. Manning. Calculation of aspect ratio, power and weight figures for an airplane with an unusually high rate of climb. The result is a 4,100 lb. airplane, with an improved 1,250 hp. Merlin engine, an aspect ratio of 8 and a span of 41 ft., which would climb at the rate of 4,800 ft. per min. Top speed would be about 399 m.p.h. *Aeronautics*, January 1941, pages 34–37, 3 illus.

Aviation's Sketch Book of Design Detail. Perspective drawings and cutaway sketches showing structural details of landing gear, fuselages, armament and sub-assemblies of German, American, and British airplanes. Included are details of the Airacobra, Vought-Sikorsky V-143, Fleetwings Trainer, Ryan ST-3, Summit HM-5, Consolidated 28, Howard Trainer, Dornier Muster Do-26, Curtiss Tomahawk and 21-B Interceptor, Republic Pursuit, Piper Cub Coupe, Taylorcraft, Fokker D-23, Airspeed Oxford, and the Hawker Hurricane. *Aviation*, February 1941, pages 120–122, 124, 127, 128, 131, 132, 137, 41 illus.

Engines

Aircraft Engine Reduction Gears and Torque Meters. Roland Chilton. With increasing power output, crankshaft speed, and propeller diameter, which require greater reduction ratios, the simple spur planitary type of reduction gear becomes inadequate, according to the writer. Among the future requirements for propeller drives are increased reduction ratios, compound reduction gears interchangeable for speed without change of gear housing, provision for two-speed gears, reverse rotating co-axial gears, and remote drive permitting engine installation in wings or fuselages, and torque meters. Designs and development of the 20-pinion reduction gear is described to illustrate the advantage of the multi-pinion design. The evolution of the torque meter is traced and the built-in design is described. *SAE Journal*, February 1941, pages 66–71, 8 illus.

Etc. A description of the new six cylinder 150 hp. air-cooled Lycoming engine. This new air-cooled power plant is similar in many ways to its four cylinder predecessor. *Air Facts*, pages 48–50, 1 illus.

The Two-Stroke Diesel Engine. Details of a proposed 6 cylinder, 2 cycle, horizontally opposed Diesel aircraft engine, with double pistons. The design was presented in a paper read before the North-East Coast Institution of Engineers and Shipbuilders in Newcastle-on-Tyne. A summary of the discussion which followed its presentation, is included with the article. *Flight*, December 26, 1940, pages e-545, 552, 12 illus.

Lycoming Horizontally Opposed 4- and 6-Cylinder Air-Cooled Engines. A description of the new series of opposed engines produced by the Lycoming Division of the Aviation Manufacturing Corp. A power range between 50 and 175 hp. is offered in this design. *Aero Digest*, February 1941, pages 14, 142, 145, 11 illus. *Aviation*, February 1941, page 139, 3 illus.

An Efficient System of Testing Power Plant Installations. Felix Kallis. A new and economical method for determining the installation of power plants devised by the engineers of the Consolidated Aircraft Corp. is the portable engine stand, which can accommodate engines up to 3,000 hp. with propellers up to 28 ft. in diameter. This article is a description of the test stand, its equipment and sound insulated control house in which conversation can be conducted at normal voice levels, despite the fact that it is usually placed alongside the test stand. *Aero Digest*, February 1941, pages 161, 162, 4 illus.

Propulsive Effects of Radiator and Exhaust Ducting. Manfred Rauscher and W. H. Phillips. This report shows how the thrust and the thermal efficiency of a ducted radiator vary with the design of the duct, the amount of radiator heating and the airplane speed. The type of duct commonly used for drag reduction is found to serve well for thrust recovery. Nevertheless, the thermal efficiency of the arrangement is so low that the thrust obtainable is unlikely to offset more than about one-third of the drag of the radiator and duct.

A study is made of the thrust given by a jet of fluid released in a duct. Conditions are found to exist under which the thrust of the ducted jet is greater than that of the jet unducted. If the jet consists of cool fluid, the thrust augmentation is secured by a venturi-shaped duct. With a hot jet, an expanding-contracting duct is required, as for a propulsive radiator. The analysis suggests that the potential benefits of exhaust ducting are of the same order as those of radiator ducting. *Journal of the Aeronautical Sciences*, February 1941, pages 167–174, 4 illus.

Thermostatic Control in Liquid Cooling. William Warfield. A description of a thermostatic valve, devised by Rolls-Royce Ltd. and the British Thermostat Company Ltd. to be installed in the radiator system of a liquid-cooled engine. The function of this thermostat, located between the header tank and the radiator, is to reduce the danger of excessive cooling, by by-passing the radiator when the temperature drops below a predetermined point. The construction of this valve and its operating process is explained. *Aero Digest*, February 1941, pages 150, 178, 2 illus.

The Aero Engines of Britain. Photographs and descriptions of aircraft engines now being manufactured in England. The engines built by the following companies are listed: Alvis, Armstrong-Siddeley, Bristol, Cirrus, de Havilland, Napier and Rolls-Royce. *Flight*, December 12, 1940, pages 506–509, 13 illus.

American Aircraft Engines for 1941. Drawings, photographs and descriptive captions about some of the new models of Amercian aircraft engines. Several engine mountings and features of design are shown. *Aviation*, February 1941, pages 101–103, 15 illus.

Development in Aircraft Power Plants. A. T. Gregory. Outline of progress made in design, performance and production of American aircraft engines during 1940. The writer believes that most important has been the development of the Wright, and the Pratt & Whitney radial engines of 2,200 and 2,000 hp., respectively. Other developments include the Allison 12-cylinder liquid-cooled engine, and the Wright G-200 Cyclone 9-cylinder radial, rated 1,200 hp. Mentioned in the smaller horsepower category were the Ranger inverted V-12 at 520 hp., the Franklin 6-cylinder horizontally opposed engine for light airplanes, and generally increased horsepower for most of the 4-cylinder horizontally opposed engines for light airplanes. It is stated that production capacity for the coming year will be about four times that of a year ago, or 5,000 per month. Developments in gear reduction and improved supercharging, are also mentioned. *Mechanical Engineering*, February 1941, pages 103, 104.

Fuels and Lubricants

Fuel Rating—Its Relation to Engine Performance. A. M. Rothrock. An analysis of the physical principles involved in knock and pre-ignition as an approach to the solution of the problem of fuel rating. By analyzing these principles, the manner in which different engine conditions influence the factors which cause knock and preignition. The writer compares his results with present methods and recommends future lines of investigation. The paper emphasizes that preignition and knock must be considered separately, and points out the difficulties encountered in attempting to express both characteristics by a single method of fuel rating. *SAE Journal*, February 1941, pages 51–65, 17 illus.

The Trend in Aviation Gasoline. Dr. F. F. Musgrave. General discussion of the problem of increasing the octane value of aviation gasoline. *Commercial Aviation*, January 1941, pages 43, 44, 1 illus.

Gliding and Soaring

Thermal Signposts. Alexis Dawydoff. A description of the phenomena in nature which indicate the beginning of a thermal. Soaring pilots are quick to recognize these, as they are a key to longer flights. *Air Trails*, March 1941, pages 27, 64, 4 illus.

Gliding for Training. M. de Bunsen. Description of gliding in Germany. The writer states that there are 25 schools, 465 camps, and 5,000 sailplanes and gliders in Germany. He also calls attention to the widespread use of gliding as a "safety valve" for the Luftwaffe. Mechanics, maintenance men, factory workers and others in monotonous or unrewarded occupations are given instruction in gliding. It satisfies both a need for recreation and their desire to fly. *Aeronautics*, January 1941, pages 67, 68, 2 illus.

History

"Always Ready." Admiral R. R. Waesche. A history of the air service of the United States Coast Guard which was first authorized in 1916. The article also gives an account of the humanitarian work which this organization performs in warning persons and vessels of danger at sea, transferring sick or injured persons from ships at sea, rescuing persons from disabled craft, as well as their function in enforcing the maritime law and scouting for obstructions to navigation. The course of instruction for Coast Guard pilots is also described. *National Aeronautics*, January 1941, pages 5, 6, 4 illus.

New Year Round-Up. George E. Haddaway. Summary of growth and progress in aviation during 1940, including figures on air transport, manufacture, civil aviation, research and the production of military aircraft. *Southern Flight*, January 1941, pages 8–11, 4 illus.

Windy Days. Major C. C. Turner. The experiences of the air correspondent of the *London Daily Telegraph* who learned to fly in 1911. Many different types of early English aircraft are shown and a detailed account of dual instruction in those days is given. As a student of the Bristol flying school he associated with many who later became famous in British aviation. *Flight*, January 2, 1941, pages a–e, 7 illus.

Early Canadian Prairie Pilots. Frank H. Ellis. An account of the author's early years of flying in Canada with William Straith and Thomas Blakely. Early equipment is shown and described. *Canadian Aviation*, January 1941, pages 34–36, 5 illus.

What—No Airplanes? Col. Edgar S. Gorrell. History of the military aircraft procurement problems of the United States in the last war. Faced with a lack of experience and production facilities, and a lack of knowledge about the types of equipment being used, this government asked to be allowed to build Allied models and accessories. The story of the many delays due to Allied demands for royalties on equipment produced in the United States, and the rapid changes in design, is told. It is stated that the first DH-4 American-built airplane with a Liberty engine reached France on May 11, 1918, and that 1,216 airplanes and 2,083 Liberty engines had been received by November 11, 1918. Col. Gorrell also stresses the importance of having an adequate air force and a well-developed and mature aircraft industry at the outbreak of war. *Journal of Air Law and Commerce*, January 1941, pages 1–24.

Flying, As It Was. Robert G. Fowler. Description of the first flight across the Isthmus of Panama, and other experiences of a pilot in the early days of flying. *The Sportsman Pilot*, January 15, 1941, pages 20, 21, 36, 38, 10 illus.

Contributi al Aeronautica e alla Dinamica Indebitamente Attribuiti a Leonardo da Vinci (Contributions to Aeronautics and Dynamics Unjustly Attributed to Leonardo da Vinci). R. Giacomelli. The author, who has spent several years in research of the contributions of Leonardo da Vinci to the science of flying, indicates that some contributions to aeronautics and dynamics have been erroneously attributed to da Vinci, such as the invention of the aerostat, the discovery of the first and third laws of motion, and the prediction of aviation on a large scale.

In this study the author tries to prove his point by calling attention to

some data in the historical development of aeronautics and dynamics, and by demonstrating how a famous drawing by da Vinci which actually is an historical-political allegory, has been misrepresented as an allegory of the terrestrial magnetic pole. *L'Aerotecnica*, November 1940, pages 834–849, 1 illus.

Vier Jahrzehnte Luftfahrzeugbau (Four Decades of Aircraft Construction). Fritz Wittekind. A review of the development of German aircraft engines during the last 40 years. *Der Deutsche Sportflieger*, November 1940, pages 224–227, 10 illus.

Instruction

S.F.T.S. and O.T.U. A complete outline of the courses taken by candidates for the various branches of the Royal Air Force. The first stage described is the I.T.W. (Initial Training Wing). Here pre-flight discipline and theory is taught. Those who survive this are sent to the E.F.T.S. (Elementary Flight Training School), where they solo, learn simple aerobatics and get their first cross-country training. Next comes the S.F.T.S. (Service Flying Training School), where the fledgling starts really becoming a soldier of the sky. Skilled officers select those who show aptitude for bombing and long range flying for intermediate training in Avros Ansons and Oxfords, while cadets with leanings toward combat flying are put on the Miles Masters and North American Harvard advanced combat trainers. From here they go to O.T.U. (Operational Training Unit), where they study night flying, gunnery, Link trainer work and celestial navigation as well as simulated abandonments. The equipment used to teach them gunnery, navigation and aeronautical discipline is described. *Flight*, January 9, 1941, pages f–h, 29, 10 illus.

South with the Birds. Advantages and facilities offered by American aviation schools situated in the south. It is stated that many R.F.C. pilots were trained in the southern United States during the last war, and the writer points out that the Canadian student is permitted to attend school in this country with a minimum of entrance formalities at the border. *Commercial Aviation*, January 1941, pages 58, 59, 140, 3 illus.

R.A.F. Instruction. Visit to an Elementary Flying Training School and an Air Observers' Navigation School of the R.A.F. Air Observers must navigate, set course, figure time, distance, and fuel problems as well as be able to serve as machine gunner, photographer, bombardier, and emergency pilot. His training is intensive and diversified. Also included in the article is a description of primary flight training for both observers and pilots. *Flight*, December 26, 1940 pages 546–548.

Canada's Open Secret. Richard Thruelsen. Description of Canada's Empire Air Training Program. It is stated that the program is well ahead of schedule, and still expanding. Brief visits to various training centers are described, including one to a recruiting center where a group of Americans was interviewed. All of them were pilots, most of them with hundreds of hours who were enlisting in Canada because college credit and educational requirements disqualified them for American military air training. The writer emphasizes the importance the British are placing upon the training of so-called air observers. It is said that for the large bomber, the air observer who is charged with navigating the aircraft is as important to the success of the mission as the pilot. Steps in the schooling of pilots, observers and gunners are outlined, and the color illustrations show many types of American equipment in use. *Saturday Evening Post*, February 1, 1941, pages 18, 19, 35, 38, 12 illus.

A Further Discussion of Down-Wind vs. Up-Wind Turns. Lieutenant Lawrence F. Motl. An attempt to refute the statement, made in the January issue of the same publication by Richard R. Bloss (page 155) that additional altitude was necessary when flying up-wind to equalize potential energy of up-wind flight with the down-wind flight of a given airplane with power off. This writer argues that the kinetic energy for flying is measured with respect to the speed of the airplane to the air, not with the ground. *Aero Digest*, February 1941, pages 121, 196, 1 illus.

"I Think I Can Make It." Wolfgang Langweische. A detailed discussion of the method of calculating a proper approach. Many pilots, according to the writer, throttle their motors and establish their glide by instinct or from memory, rather than any reasoned formula or method. This article analyzes the problem of approach, indicating an exact method of determining the exact time to throttle the engine and to check unnecessary overshooting or undershooting of the airport. *Air Facts*, February 1941, pages 16–26, 5 illus.

The Aerostructor. A description and explanation of the Aerostructor, a new device intended to do the same job for contact flying as the Link Trainer does for instrument work. The idea, developed by A. C. Travis, Jr., and Robert E. Fulton, Jr., consists of a conventional set of dual airplane controls at which both the student and the instructor look through a porthole and see a realistic over-the-nose view of the horizon. Other common flying sensations, such as slips, skids and stalls are authentically reproduced. This is accomplished by a simple beltlike film, which is shifted directly by the controls, simulating the movement of the horizon as the pilot would see it. The principle of operation of the new device and some of its uses are outlined. *Air Facts*, February 1941, pages 8–15, 4 illus.

The Pylon Eight. Daniel J. Brimm, Jr. An explanation of the proper method of performing the figure eight on pylons, a maneuver required as part of the C.P.T.P. secondary flight training program. The manner in which speed determines the required altitude is explained. *Aero Digest*, February 1941, pages 157, 158, 5 illus.

How to Train Defense Workers. Henry F. Pringle. A description of the industrial schools in Connecticut, being conducted jointly by the State and defense manufacturing companies, which are providing men for defense industries. United Aircraft Corporation factories are among those being furnished help by these schools. *Collier's*, January 18, 1941, pages 23, 46, 47, 3 illus.

What Is the Rudder for? Wolfgang Langwiesche. An explanation of the various uses of the airplane's rudder. The function of this control during a turn is frequently misunderstood by students, chiefly because it is never properly clarified. The article shows that the actual use of the rudder in a turn is to counteract negative yaw rather than to turn the airplane. *Air Facts*, January 1941, pages 42–46.

I Learned to Fly. T. J. Young. Personal experiences of a college undergraduate who took the Civilian Pilot Training Course. *Air Youth Horizons*, January 1941, pages 5, 8, 1 illus.

Training Plan Highlights 1940 Air Effort. Chronology of Canada's war effort in aviation during 1940. It is shown that the air training plan is 25 per cent ahead of schedule. *Canadian Aviation*, January 1941, pages 20–22, 36, 4 illus.

A Preparedness Picture of the Civilian Pilot Training Program. Guy W. S. Castle. Comments on the C.P.T.P. by Grove Webster, National Director of the Program, Jesse Jones, Secretary of Commerce, and the operators of several C.P.T.P. schools. Grove Webster, indicating that the program has progressed according to

schedule, said that one of the immediate problems was the securing of a sufficient number of qualified instructors. The Secretary of Commerce, in summing up the work of the C.P.T.P. revealed that more than fifty-five per cent of the graduates of the Program's secondary course had been accepted by either the Army or the Navy. The article also includes opinions on the program and its bearing on preparedness by flying and ground-school operators training C.A.A. students near Washington. *U.S. Air Services*, January 1941, pages 19, 22, 36, 1 illus.

Structural Strength of Aircraft. Assen Jordanoff. Another in a series of articles based upon the book *Your Wings*. This one deals with the load effect of acceleration on airplane structure, terminal velocity dives, and gust acceleration loads. Landing loads and shock struts are discussed. *Canadian Aviation*, January 1941, pages 27, 28, 33, 4 illus.

John Smith Joins the Air Force. A picture account of the physical examination and early training of a candidate for the R.A.F. *Illustrated*, January 1941, page 30, 12 illus.

Getting Their Wings—I. Part one of a series on the various stages in training an R.A.F. pilot. Stage 1 is the Initial Training Wing, which consists of school training only, plus a trip in a Link trainer. Stage 2 is the Elementary Flying Training School, with a continuation of ground training and the beginning of primary flight training. Motion pictures are used in both ground and flight training. *The Aeroplane*, December 27, 1940, pages 726, 727, 6 illus.

Getting Their Wings—II. Report of a visit to an Elementary Flying Training School where R.A.F. students begin their training. Six hours are put in on a Link trainer before regular flight instruction begins. By the end of that time students can fly a triangular course on instruments in addition to getting the feel of the controls. Preliminary training of Air Observers or navigators is also described. *The Aeroplane*, January 3, 1941, pages 12, 13, 4 illus.

I'll Punch a Time Clock. Roderick MacNeil. A production mechanics student at California Fliers School in Inglewood, California, describes the course he is now completing and tells why he believes his latest investment in education will be the key to unlimited future opportunity. *Air Trails*, March 1941, pages 21, 54, 55, 3 illus.

The Making of a Pilot. Boone T. Guyton. First-hand description of Navy pilot training, written by one who has been through it. From the moment the cadet is welcomed to the day his wings are pinned on, intensive study, training and practice take up most of his waking hours. Service tradition and organization, radio, airframes and engines, navigation, meteorology, aerodynamics fill the hours devoted to ground school, and some 350 hours of flight instruction, practice and check must be experienced and thoroughly assimilated to pass a series of sixteen checks which mark the various stages of training. Sensations following the first spin, and other acrobatic maneuvers are described and amusing examples of ironic comment by the instructor, are given. *New York Times Magazine*, January 12, 1941, pages 1, 6, 7, 19, 8 illus.

Ground Engineers' Examination. T. R. Thomas. Suggested changes in requirements for British ground engineer certificates. These certify to the holder's qualifications to inspect airplanes and to verify airworthiness or order repairs. They in no way indicate the holder's competence to make such repairs or service airplanes as does the American mechanic's certificate. The writer believes that a change to the latter type is desirable. *Flight*, December 19, 1940, pages 528, 529.

Stall Technique. H. H. Strickland. Discussion of stalls at various attitudes and practice methods by which the pilot can learn the feel of an approaching stall. It is stated that more than half of the serious accidents follow a partial or complete stall at low altitudes. *The Sportsman Pilot*, January 15, 1941, pages 12, 13, 48.

Jobs Guaranteed. John H. Pinkerman. Details of the Vought-Sikorsky employee training plan. Like the other divisions of United Aircraft Corporation and manufacturers working on defense contracts in the state of Connecticut, Vought-Sikorsky has equipped a portion of the State trade school at Bridgeport and cooperated in the training of skilled plant personnel. The plan is described together with some of the results to date. *Flying and Popular Aviation*, February 1941, pages 42, 43, 74, 3 illus.

Instruments

Whither Are We Drifting? Prof. Bradley Jones. A discussion of the navigation taught C.P.T.P. students, showing the need for drift indicators in the training airplanes. *U.S. Air Services*, January 1941, pages 23, 24.

Quantity Production of Gyro Instruments. P. R. Bassett. Outline of production problems in the quantity production of gyro instruments. It is stated that the Sperry Gyroscope Company had to overcome the problems of highly skilled labor and training in building precision instruments by a program of long-range planning based upon lessons learned in the last war. By a system of educational orders to sub-contractors, based upon M-day plans formulated after the World War, the company was able to expand production by 800 per cent last year. It is said that the rate of production can be expanded still further for an emergency and later can be lowered to peacetime production without serious waste or dislocation. *Mechanical Engineering*, February 1941, pages 98–100, 124, 2 illus.

Instrument Flying

Gyromatic Navigation. William P. Lear. A description of the construction and use of the Lear Gyromatic Navigator, the new radio navigation instrument which combines the indications of the automatic radio direction finder with those of the directional gyro. Examples of the use of the new instrument are given. *Aero Digest*, February 1941, pages 66, 71, 3 illus. *Commercial Aviation*, January 1941, pages 46, 47, 55, 4 illus.

Homer. Harold A. Marquis. A description of an automatic radio directional control, developed by the Harvey Machine Co. The device holds the airplane on a straight-line flight path between two radio stations, regardless of the speed or direction of the wind. *Flying and Popular Aviation*, February 1941, pages 47, 48, 4 illus.

Law

Aeronautical Law Developments in 1940. George B. Logan. A review of court decisions of cases involving points of interest on insurance, C.A.A. regulations, condemning land for the expansion of airports, and an air photographer's suit against the United States. Aeronautical Acts of Kentucky and Rhode Island are also discussed. *Journal of Air Law and Commerce*, January 1941, pages 33–50.

Some Phases of Aeronautical Tax Law. Professor John A. Eubank. The first in a series on tax legislation affecting aviation. This installment deals with the background of the gasoline tax, quoting from early court decisions that had direct bearing on the taxation of airplane fuel. *Aero Digest*, February 1941, page 102.

Manufacture

De Havilland Rolls 'Em Off. Description of rapid expansion at the

de Havilland Aircraft Company's Toronto plant. Figures of the past year show a 2,000 per cent increase in personnel, 800 per cent increase in plant size, and production increased to 2.8 Tigers per day and 15 Battles and Avro Ansons per month. Some details of construction are described, in producing the de Havilland Tiger Moth. *Commercial Aviation*, January 1941, pages 31–33, 5 illus.

Martin B-26. Brief account of how The Glenn L. Martin Co. tooled for production of the B-26 medium bomber without waiting for a large-scale order from the Government. As a result production was well under way when the first quantity order was received. Features of design and armament are also given. *Commercial Aviation*, January 1941, pages 51, 56, 2 illus.

Light Plane Industry Prepares for Mass Production. Kenneth W. Tibbits. The builders of light commercial airplanes, unlike the manufacturers of military equipment, received little direct help from the rearmament program. Their sales, in the future, must be made to private owners. Looking forward to the day when mass production will be made possible by mass sales, many new production devices are being considered and adopted. These include such devices as the Onsrud Router, the mechanical stapler as a substitute for hand riveting and spot welding machines. The use of Masonite and typemetal for dies is considered a step in applying methods used in producing larger aircraft to the light plane field. Welding problems in light plane production, and the possible future use of electric welding is also discussed. *Aero Digest*, February 1941, pages 134, 137, 138, 194, 12 illus.

Progress in Aviation Accessories. R. P. Lansing. Brief discussion of developments in the simplification of aircraft accessories resulting from quantity production. *Mechanical Engineering*, February 1941, pages 102, 103.

How to Speed Production—Suggestions from an Expert. Paul G. Zimmerman, Douglas Aircraft Co. (Ed. note: See **"Some Simple Methods of Speeding Up Airplane Production,"** S.A.E. preprint for National Aircraft Production Meeting, *Aero Digest*, November 1940, reviewed on page 17, of the *Aeronautical Review*, December issue.) *Canadian Aviation*, January 1941, pages 37–39, 3 illus.

Occupational Hazards in the Aircraft Industry. Suggestions for safeguarding health and safety of personnel in aircraft plants. Precautionary measures are described for handling of dopes, cleaning materials, as well as safeguarding against noxious fumes from welding operations, carbon monoxide poisoning, and the fumes of anti-knock gasoline. Typical protective goggles for welders and machinists are shown with signs of warning that they be used while working. *Canadian Aviation*, January 1941, pages 40, 41, 2 illus.

Improved Methods for Machining Engine Parts. The application of new and improved machine tools is rapidly changing aircraft engine production methods. Among newest of these is the Colonial Universal Horizontal Broaching Machine, which can machine the slots in an aircraft engine counterweight in five operations. Gear production can be accelerated by a new two-lap lapping machine, developed by the Michigan Tool Company. The functions of both of these machines are described in this article. Another development described here, is a coolant for all machines using carbide tools, which was developed by the Carboloy Co. This new lubricant, introduced at the vital point between the chip and the tool, tends to stiffen the chip, making it easier to break. *Aero Digest*, February 1941, pages 153, 154, 3 illus.

Technical Progress in Aviation. J. C. Hunsaker. Outline of technical progress in American aviation. Included are more recent developments in aerodynamics, engines and engine cooling, jet propulsion, and a discussion of the radial air-cooled *versus* the liquid-cooled engine in high-speed military aircraft. The writer states that the N.A.C.A. has developed a means of streamlining the American radial air-cooled engine so that its drag can be made as low as that of the best liquid-cooled engine installation. He also discusses the problem of whether mass production should be planned on the basis of 1,200 hp. liquid-cooled engined military aircraft, such as are being used today, or upon the 2,000 hp. air-cooled radials now in production by two American manufacturers. *Mechanical Engineering*, February 1941, pages 95–97.

Principles of Jig and Fixture Practice. Joseph W. Roe. Discussion of economic and design factors in the use of machine tools and jigs in quantity production. In the first part of the article the writer offers several formulas for accurately appraising the value of equipment in question. By working the equations offered, questions such as number of pieces, length of run, allowable fixture investment and time required for it to pay for itself can be readily solved. In the second part, the writer discusses certain details of jig and fixture design. Included are feeds, locating, clamping, jig legs, latches, and bushings. *Mechanical Engineering*, February 1941, pages 117–124, 17 illus.

How Many Firms Make an Airplane? A survey of the number of businesses involved in aircraft manufacture, showing that the first supplier to the aircraft constructor is the company making drafting supplies. The effect that the exacting demands for strength, lightness and reliability which the airplane builders have made on their suppliers is shown in the improvements in materials and methods which have been made recently. *Flight*, December 12, 1940, pages 510, 511.

Building the Bombers. Description of a visit to a Whitley bomber factory. It is stated that much of the simple repetition work is carried on by women and girls who have been drafted into aircraft production only in recent months. The high morale of the personnel and concentrated speed with which they are doing their work impressed the writer. It is said that the man-hours needed to build a Whitley have fallen by nearly one-half since the first of these aircraft were produced. *The Aeroplane*, January 10, 1941, pages 42, 43, 6 illus. *Flight*, January 2, 1941, pages 13–16, 10 illus.

Taper-Bore Rivets. Details and recent developments in the Chobert system of blind riveting. The mandrel or upsetting tool is tapered instead of threaded, and when drawn through the inversely tapered hole of the rivet, upsets or broaches the rivet. A method for compound riveting of hollow members is also shown. *Aircraft Production*, January 1941, page 25, 2 illus.

Rivets from Light-Alloy Sheet. A method by which rivets are cut, rolled and formed from sheet metal. *Aircraft Production*, January 1941, page 26, 4 illus.

Machining a Gear Blank. Feed, speed and tooling data for automatic lathe operations on a reduction gear blank for a radial airplane engine. Four machining operations are described, and speed, spindle speed, feed, length of cut, and time required is given in table form for each operation. *Aircraft Production*, January 1941, pages 5, 6, 8 illus.

Producing the "Shadow" Blenheim—Part I. Bruce Foster. A detailed presentation of the British "shadow" factory production system as applied to fabrication and assembly of the Bristol Blenheim bomber. The Rootes shadow factory was designed and built with Government

funds by automotive plant experts for quantity production of the Blenheim. As production got under way, difficulties inherent in aircraft production began to arise. Tolerances, modification, material supply and specifications were among the many problems which were finally worked out satisfactorily. The writer states that the secret of speedy large scale aircraft production, is to build in components, each as complete and small as possible, before it is joined to others in sub-assembly. This enables the greatest number of men to work on one airplane simultaneously, thus producing it in the shortest possible time. The principle of quantity production is well illustrated in both pictures and description of the Rootes plant. Fabrication of components and sub-assemblies is shown in various parts of the plant, and many of the operations are described. Parts covered in this installment include spars, end fittings, main plane assembly, tail plane, control surfaces, in addition to a special discussion on sub-assemblies, drilling equipment, riveting and woodworking. *Aircraft Production*, January 1941, pages 7–16, 21 illus.

Finishing Stainless Steel Welds. Description of a special method for grinding, polishing and buffing stainless steel welds. Grinding speeds, wheel composition, buffing, buff lubricants and electro-polishing are treated briefly, and a table offered of recommended materials and surface speeds of their application. *Aircraft Production*, January 1941, page 32, 33, 1 illus.

Materials

Magnesium Alloys in the Aircraft Industry. John C. Mathes. A summary of the present use of magnesium alloys in aircraft construction, showing how even wider use of it may be made in the future. The writer indicates a favorable comparison in strength between new magnesium alloys and aluminum, showing how it is possible to overcome the lower modulus of elasticity as it affects compression members, and still retain a considerable saving in weight. *SAE Journal*, February 1941, pages 76–80, 2 illus.

Compressed Impregnated Timber. R. M. Lloyd. Outline of properties and uses of super-pressed plywood or laminated wood in aircraft spars. *The Aeroplane*, December 13, 1940, pages 682–684, 6 illus.

War Lessons Influence the Development of New Paint Products. Frank W. Fuller. Wartime activity has stimulated new research in the field of special paint products for all-weather protection but also for camouflage. Some of the latest developments in night, day, and low visibility concealment of aircraft through special paint application as well as recent improvements in non-inflammable dope, sealing compounds and allied paint products are described. *Aero Digest*, February 1941, pages 59, 60, 5 illus.

Compounding Plastics and Wood by a New Process. R. Decat. A description of a new method for bonding wood by means of thermo-setting plastics, which gives the converted material many desirable characteristics. This article explains the standards by which the species and particular stocks of wood are selected, the improved method by which seasoning time is accelerated as well as the technique for actually moulding the wood into the desired shape. The procedure for building propellers by this process is outlined. *Aero Digest*, February 1941, pages 146, 149, 194, 4 illus.

High Strength Alloy Castings. Die-cast and sand-cast high-strength aluminum alloy castings are now being used in many parts where wrought materials were formerly considered indispensable. The development of improved casting alloys is outlined, together with a discussion of some of the advantages of gravity die-casting. *Aircraft Production*, January 1941, pages 3, 4, 6 illus.

Magnesium Alloys. John C. Mathes. Digest of a paper read before the National Aircraft Production Meeting of the Society of Automotive Engineers. Discussion of the increased use of magnesium alloys in aircraft manufacture. The writer lists engine castings and parts now being made of magnesium alloys, outlines the advantages of magnesium and offers comparison data between magnesium and aluminum alloys. Experiments with a magnesium tail fin of pure monocoque, are also described. *Aircraft Production*, January 1941, pages 17, 18, 2 illus.

Meteorology

A Photoelectric Study of Atmospheric Condensation Nuclei and Haze. N. E. Bradbury and E. M. Fryer. A method is described whereby the opacity of the atmosphere is determined by the extinction of a beam of light. By the use of a chopped light beam, photocell, and an a.c. amplifier. The apparatus may be made independent of any amount of stray light and hence can function during both the daylight and night hours. Continuous records have been made of atmospheric opacity over a period of several weeks and the results compared with the extinction to be expected as the result of Rayleigh scattering by atmospheric condensation nuclei. The results show a maximum of scattering and hence greatest opacity in the hours near sunrise when the relative humidity is highest and the nuclei largest. During other hours of the day, the opacity is a function of the density of condensation nuclei, their size (as determined by the relative humidity), and the amount of non-nucleic matter (largely dust) in the atmosphere. *Bulletin of the American Meteorological Society*, December 1940, pages 391–396, 6 illus.

Developments in Meteorology. George F. Taylor. Progress in meteorology in 1940. The writer states that one of the effects of the war on meteorology has been the almost complete absence of daily synoptic weather reports from more than one-third of the northern hemisphere. However, improvements have been made in the application of meteorology to weather forecasting, and the rapidly growing demand for weather information has increased the number of persons engaged in this field. Also mentioned are two new centers of advanced meteorological training which have been founded during the past year; one at the University of California and the other at Chicago University. *Mechanical Engineering*, February 1941, pages 104, 116.

Upvindara Och Dera Orsaker (Up-Currents and Their Causes). Walter Persson. The first of a series of articles on up-currents, treating the following subjects: dynamic soaring, thermal soaring and real sailing flight; dynamic up-currents and thermal up-currents; normal condition of the atmosphere, adiabatic variations of temperature at dry air and at humid air. *Flygning*, December 1940, pages I–III, 6 illus.

Nagot om Isbildning pa Flygplan (Notes on Ice Formation on Airplanes). Tage Svensson. A mathematical study of ice formation, based on meteorological observations in 1937 and 1938, with reference to the article "Ueber die Vereisung von Luftfahrzeugen" in Beitraege zur Physik der freien Atmosphaere, 1932, Vol. 18. *Flygning*, November 22, 1940, pages I–III, 21 illus.

Military Aviation

Stratosphere Attack. Noel Pemberton-Billings. A discussion of the possibility of attack from the sub-stratosphere and the problems involved in this type of operation. Rumors emanating from Germany say

that the Luftwaffe is developing a high-flying bomber. At present, England has no airplanes in production capable of combating this type of attack. The article outlines the work on high-altitude flying done by private manufacturers in England and by aircraft manufacturers, air lines and by the Army Air Corps in the U.S. The development of Diesel engines in Germany and the United States is also discussed. *Flight*, December 12, 1940, pages 502–504.

Blitzkrieg Warfare Tried in 1918. G. H. Mosher. Description of the two-way radio phone communication used by No. 22 Bristol Fighter Squadron in the last war. It is stated that the squadron directed a successful tank action from the air, as an experiment, but that the idea was shelved because no record had been kept of communications between the airplane and tank. *Commercial Aviation*, January 1941, pages 38, 39, 54, 2 illus.

Our Daily Bread. An account of the activities of the R.A.F. Coastal Command. Charged with coastal reconnaissance duties, Coastal Command pilots carry out long over-water patrol flights in every kind of weather. Their airplanes include many obsolete craft and slow flying boats, yet their losses are relatively small. Navigation problems of the Coastal Command are described and many amusing instances given of pilots finding the way back after they had been given up for lost. The need for many more flying boats, such as are being built for England by the United States, is also discussed. *Indian Aviation*, September 1940, pages 223–227.

Photographic Reconnaissance. Study of modern air reconnaissance and the importance of aerial photography in the present war. It is said that anti-aircraft gunfire has forced photographic reconnaissance up to the 20,000 foot level, which has caused additional problems in both equipment and method. The problem of automatic shutters being closed prematurely at night by the action of searchlights and tracer ammunition is also explained. *Flight*, December 26, 1940, pages b–d, 3 illus.

Eagles Over England. Quentin Reynolds. In answer to American news items about the faults and inadequacies of American-made combat airplanes, the writer quotes from an interview with Lord Beaverbrook, "Not a word of truth in it." He then describes his subsequent investigations and interviews at assembly plants with test pilots as well as pilots of operating squadrons which support Lord Beaverbrook's opinion that ". . . they are magnificent aircraft." *Collier's*, January 25, 1941, pages 13, 49, 1 illus.

American Military Airplanes Will Meet Every Test. T. N. Sandifer. A defense of American-built military aircraft against the charges recently made against them. It was stated by some writers, late last year, that U.S. military aircraft sent abroad were of little use to the British or her allies, due to inferior performance, lack of armor, self sealing tanks and heavy armament. The writer indicates that this conclusion was drawn from aircraft hastily sent abroad to cover emergency conditions. Comparative performance figures on new type British and American aircraft and their armament, show that the late type American ships equal if not surpass the British in performance. *U.S. Air Services*, January 1941, pages 16–17, 34, 1 illus.

Women Pilots in National Defense? Betty H. Gillies. The work of the Air Transport Auxiliary, an organization of pilots not eligible for active service, which includes over a score of women pilots, has made the question of women pilots in the National Defense Plan subject to wide argument. The National President of the Ninety-Niners, discusses the use of those women who already have considerable skill not only as ferry pilots but as navigators, control tower operators and meteorologists, to relieve pilots of military age for active combat work. Minimum requirements for such service and suggestions for training are also given. *National Aeronautics*, January 1941, pages 21, 34, 1 illus.

Night Fighting. Discussion of some of the unsolved problems of fighter defense against night bombing attack. The possible solutions of either artificial illumination or a special apparatus to enable the human eye to see at night are outlined. *Aeronautics*, January 1941, pages 40, 41, 2 illus.

Let's Protect Our Plants. Col. Charles Wayne Kerwood. One of the most important military problems in modern warefare, according to Col. Kerwood's article is the protection of the plants producing airplanes, engines, accessories, etc. According to observations made by American experts abroad, Germany's factory damage thus far is negligible, because airplane plants were removed to remote places and wherever possible buried underground or otherwise protected. France failed to provide any such protection except in one case, and the result was this plant is almost the sole survivor.

The article outlines the method by which industrial centers in the United States could be defended, indicating that almost all of the aircraft and engine factories are within striking distance of carrier-based aircraft. Some of the latest precautions applied in new factories and additions to existing airplane plants are outlined. *Air Trails*, March 1941, pages 24, 45, 59, 60, 4 illus.

The Function of Range in Air Operations. Capt. Norman Macmillan. An analysis of the many ways that range, or the effective radius of action, of military aircraft influences air strategy and operations. It is shown that range imposes a process of gradual elimination of air fleet effectiveness, affects the raid frequency capacity, affects hitting power through bomb load and raid frequency, and affects personnel through frequency and duration of strain. The writer stresses the importance of having sufficient air bases within striking range of the enemy by all units of the air force. The effects of range are applied to the British air operations in Norway as compared with those in Greece and Albania, to show what a severe handicap the lack of bases in Norway was to the R.A.F. *Aeronautics*, January 1941, pages 26–29, 3 illus.

Food for Flight. Frank Willcocks. Cusine and dietary habits of the R.A.F. Included is a list of various emergency rations as well as typical daily menus. *Aeronautics*, February 1941, pages 43, 44, 1 illus.

At a Wellington Station. Major F. A. de V. Robertson. Description of a visit to the Group Headquarters of several bomber squadrons. It is stated that most of the long-range night-bombing activity of the R.A.F. has been carried out by Wellington bombers. While there is comparatively little fighting to be done on night bombing missions, it is said that crews of this group have seen plenty of action over Dunkirk, and in day raids over Germany and the Channel ports. Incidents in these raids are described together with some of the daily activity at a bomber station. *Flight*, December 19, 1940, pages a–e, 17 illus.

The R.A.F. and the Army. Further discussion of the new Army Cooperation Command. Created for reconnaissance and other special army missions, the new Command will also insure efficient coordination between Army and R.A.F. in large-scale operations. *Flight*, December 19, 1940, page 527, 1 illus.

New Eagles for the Army. Leonard Engel. Survey of the various military aircraft in quantity production for the Army Air Corps. These include the

Bell, Lockheed, and Curtiss fighters, as well as medium and heavy bombers by Consolidated, Douglas, North American, Martin, and the Douglas and Curtiss dive-bombers. Development of several of these types is outlined, and approximate performance figures are given. Range and load requirements for military aircraft defending the United States are also discussed. *Flying and Popular Aviation*, February 1941, pages 14–16, 67, 81, 9 illus.

Night Bombardment—With a Camera. Robert S. Johanson. Description of a new and more powerful photographic flash bomb. It is stated that its illumination is equal to that of daylight at sunrise or sunset. Its flash, lasting about one-sixth of a second, makes possible night photographs with daylight accuracy. *Flying and Popular Aviation*, February 1941, pages 44–46, 89, 5 illus.

Miscellaneous

Hands Across the Sea. Story of a Christmas gift from the employees of the Lockheed and Vega aircraft factories, to the people of England. Funds were raised for the purchase of a Lockheed-Hudson bomber, which was delivered at Montreal on Christmas day. *Commercial Aviation*, January 1941, pages 66, 134, 2 illus.

The Government Needs Aero Technicians. Amy A. Harradon. A list of Civil Service positions under the Civil Aeronautics Administration and the Army Air Corps which are offered through the Recruiting Section of the Civil Service Commission. The salaries and requirements for the following positions are listed: Associate and Assistant Aeronautical Inspector, Aeronautical Engineer, Instructor, Associate Factory and Air Carrier Inspector, Draftsmen, Engineering Aide, Materials Inspector, Junior Engineer, Airway Traffic Controller and Aircraft Procurement Inspector. Procedure for application is outlined. *National Aeronautics*, January 1941, pages 14, 15, 4 illus.

They Wanted Wings. Kurt Rand. An account of the filming of "I Wanted Wings," a new aviation picture based on Flying Cadet life at Randolph and Kelly fields. *Flying and Popular Aviation*, February 1941, pages 36–38, 84, 7 illus.

I.Ae.S. E. Jay Doherty. Description of the facilities and services of the Institute of the Aeronautical Sciences. Service of The Paul Kollsman Library, by which aeronautical books are loaned without charge by mail to responsible persons, is outlined, together with a description of the W. A. M. Burden reference library, the Aeronautical Archives, and the Aeronautical Index of bibliographies and current aeronautical literature. A history of the Institute, its background, its membership and steady growth, is also given. *Flying and Popular Aviation*, February 1941, pages 18–20, 86, 87, 9 illus.

Lek-en Brandvrije Benzine-Tank (Leakproof and Fireproof Gasoline Tank). Examination of German bombers shot down in England revealed that they are vulnerable at several points, but that they also have some well devised equipment. The most important is the leakproof gasoline tank. The principle of the leakproof tank is not new: it has double walls and a latex layer between them as a baffle. In case a leak occurs the gasoline comes in contact with the latex causing it to become plastic thus sealing the leak. However, this theory very often does not hold good in practice. For instance, when a projectile perforates the tank wall it leaves a burr in the metal, and this burr often prevents the latex from sealing the hole. The baffles which form the tank walls of the German bombers consist of vulcanized rubber, leather, and compressed fiber. A bullet which goes through such a wall leaves a clean hole. The inner part which touches the gasoline is a fiber layer $1^1/_2$ mm. thick. This layer has a leather cover which protects it against an eventual breakage due to vibrations, or to shock at a crash. On top of this leather is a thin rubber layer, covered by a latex layer which is 6 mm. thick. This again is covered by a thin layer of vulcanized rubber over which finally a hard rubber outer wall is placed, to which fastening strips are attached. *Luchtvaart*, November 5, 1940, page 411.

Optical Flats. Surface inaccuracies which are too small to be measured by a micrometer, can be checked by means of optical flats. This is based upon the fact that if a glass or quartz plate is put into contact with another flat surface, a series of color fringes or bands appear and indicate by their pattern both the form and extent of inaccuracy in the surface being checked. Various uses of optical flats are shown and explained. *Aircraft Production*, January 1941, pages 34, 35, 6 illus.

False Accusations. C. G. Grey. The writer defends himself against charges of his being overly severe in his criticism of American aircraft. He points out that he has often been accused of being pro-American because of his enthusiasm for certain types of American engines and airplanes. He states that recent criticism of obsolete craft being "planted on" England has been justified by expert opinion both in England and the United States. A discussion of the secret American bombsight and the Boeing "Flying Fortress," is also included. *The Aeroplane*, pages 677, 679, 3 illus.

Standardized Airplane Seating. Warren McArthur. Description of modern seats for military and passenger aircraft. Details of construction and load specifications are given. *Western Flying*, January 1941, pages 20, 21, 7 illus.

A New Vacuum Pump. Details of design and construction of a vacuum pump weighing $2^1/_2$ lbs. which delivers 17.3 cu.ft. of free air per minute, at a back pressure of 8 in. and a suction of 6 in. Hg, running at 3,500 r.p.m. *The Aeroplane*, January 10, 1941, pages 54–56, 11 illus.

Model Airplanes

Youth Learns with Models. Dr. George W. Lewis. The Director of Research of the N.A.C.A. points out the educational advantages of model building as a hobby, praising the sportsmanship which model competitions engender. Facts about the N.A.C.A.'s own model builders, almost all of whom are young men who trained themselves by building competition models, are given. *Horizons*, January 1941, pages 3, 4, 1 illus.

Building Scale Models. Suggestions in the selection of materials and construction of solid scale or non-flying model airplanes for exhibition or research purposes. *Air Youth Horizons*, January 1941, pages 7, 10, 12, 3 illus.

2,000,000 Young Americans Get Boost to Aviation Careers. John Hennessy Walker. Story of Air Youth of America. Idea of the late Frank Hawks, Air Youth of America has been carried on in memory of him. The organization is headed by Winthrop Rockefeller and Thomas H. Beck, and its activities have been concentrated on helping model airplane builders to form clubs and organize contests. Its aim has been to serve as a non-commercial advisory organization to millions of youngsters interested in aviation. Included is a description of the organization and its activities. *Popular Science*, March 1941, pages 50–53, 8 illus.

Why Not Scale Gas? Fulton H. Travis. A model airplane club in Yakima, Washington, recently conducted a novel model airplane contest. Instead of the usual scale and flying model competition, the club tried a

flying scale contest for gasoline powered models. The winner was Rex Baumgardner, with a 1/5 hp. model of a Fleetwings L-5. A description of the winning craft and an account of the unique contest are given. *Air Trails*, pages 35, 51, 1 illus.

Stout Trophy Winner. Caldwell Johnson. A description of the engineering and construction of the rubber powered model which won the 1940 Stout Trophy competition. Plans of this consistent contest winner are included. *Air Trails*, March 1941, pages 38–40, 52, 53, 5 illus.

Motor Saver. Maurice Schoenbrun. A new method for installing engines on an adjustable motor mount. This mount, differing from the "built-in" type, is attached to the motor bearer with match sticks. If properly installed it holds surprisingly well, having the advantage of saving the structure in case of a crash landing. The match sticks break, thus sparing the motor mount. *Air Trails*, March 1941, pages 35, 64, 1 illus.

Naval Aviation

Down at Sea. Lieut. Comdr. Don Smith. An account of a forced landing at sea in a landplane made by Lt. Frank T. Corbin of the aircraft carrier *Lexington* during maneuvers off Southern California. The article describes the events which preceded the involuntary descent into the ocean and the deportment of the Navy men in effecting their rescue and the salvage of the airplane. *Air Trails*, March 1941, pages 20, 47, 48, 4 illus.

The Air and the Sea. Major F. A. de V. Robertson. Background and development of the British Fleet Air Arm as it is used today. While it is admitted that aircraft carriers are vulnerable in inland waters, the writer believes that the victory of carrier-based torpedo airplanes over the Italian fleet at Taranto was well worth the risk. Naval work of the Coastal Command is also described. *Aeronautics*, January 1941, pages 30–32, 4 illus.

Coastal Command. J. Stubbs-Walker. An illustrated account of a patrol flight in an R.A.F. Coastal Command Sunderland flying boat. Flying far out to sea, this aircraft contacted a convoy, scoured the surrounding sea to make sure it was safe and returned to its base. A description of the interior of this four-engined patrol airplane and the functioning of its crew is given. *Illustrated*, Royal Air Force Special Number, January 1941, pages 26–29, 9 illus.

Aircraft Carriers. The attack by the Fleet Air Arm's torpedo-aircraft on Taranto harbor demonstrated the great military value of the aircraft carrier. Such spectacular success, however, should not, according to this article, be permitted to overshadow the spendid work that this type of vessel has performed during the Norwegian campaign, at Tobruk, and other less publicized actions. The article names and describes every known aircraft carrier, giving statistics such as displacement, length, draft, power, armament, number of aircraft, etc. Drawings of many of these ships, made to a 1 inch to 116 foot scale, are given. *Flight*, January 1941, pages a–e, 22 illus.

The Royal Air Force and the Royal Navy Cooperate to Destroy an Italian Submarine. Photographs of the effect of depth charges, shells, and air bombs on an Italian submarine. The submarine was originally spotted by the Fleet Arm airplane, forced to come to the surface by depth-charges, relocated and bombed by the airplane and finally sunk by the destroyer's guns. *War in Pictures*, December 1940, page 13, 3 illus.

Navigation

Time and Celestial Navigation. Frederick Harrison Tregenza. Second in a series on celestial navigation. The writer outlines the important part that time and the accurate measure of time plays in navigation. The first point of Aries, the solar and sidereal day, the equation of time and movements of the stars are explained, and several diagrams offered as examples. *Commercial Aviation*, January 1941, pages 36, 37, 55, 3 illus.

The Mark IX Sextant. Francis Chichester. Details of a new sextant designed by P. F. Everitt, research engineer for Henry Hughes and Son, Ltd., which it is said reverts to the marine sextant form of optics. Interesting features of the instrument include improved lighting of the bubble against a dark background, with a pencil of light falling on each scale and the observer's wrist-watch; and a totalizing unit which permits six rapid shots to be taken and automatically averages them for the observer. Method of setting and operation is described. *The Aeroplane*, December 13, 1940, pages 669, 670, 6 illus.

Bombing Unseen Targets. Francis Chichester. Detailed outline of a method for night-bombing of unseen target areas by means of highly accurate celestial navigation. The writer shows that because of deflection, the intersections of radio beams can result in a wide range of error. In the celestial method and problem described, it is shown that errors of drift, groundspeed, and course are steadily reduced through a series of "fixes," as the target is approached, so that total final error can be held to within 1.3 miles. The writer's plan calls for several navigation aircraft to accompany a bomber fleet. Personal, index, and aircraft error would be reduced to a minimum with multiple simultaneous observations, from pressure controlled observation cabins. The plan also entails the use of the "datum-line" method of celestial navigation. One star is kept on, or nearly on the beam, while a second is chosen whose bearing is on or near the course. The former checks the course and the latter gives a check on distance made good. A sample problem involving a raid on Berlin is described, including methods of observation, timing, correlating data, and plotting and correcting the course flown. *Aeronautics*, February 1941, pages 50–56, 6 illus.

Evolution of the Air Almanac. Lieut. Comdr. P. V. H. Weems. The history of the American Air Almanac, describing its predecessors, the various marine almanacs, and its relation to the British Air Almanac. All of the changes which the book has undergone since it first appeared in 1928 are outlined. *Aero Digest*, February 1941, pages 65, 159, 2 illus.

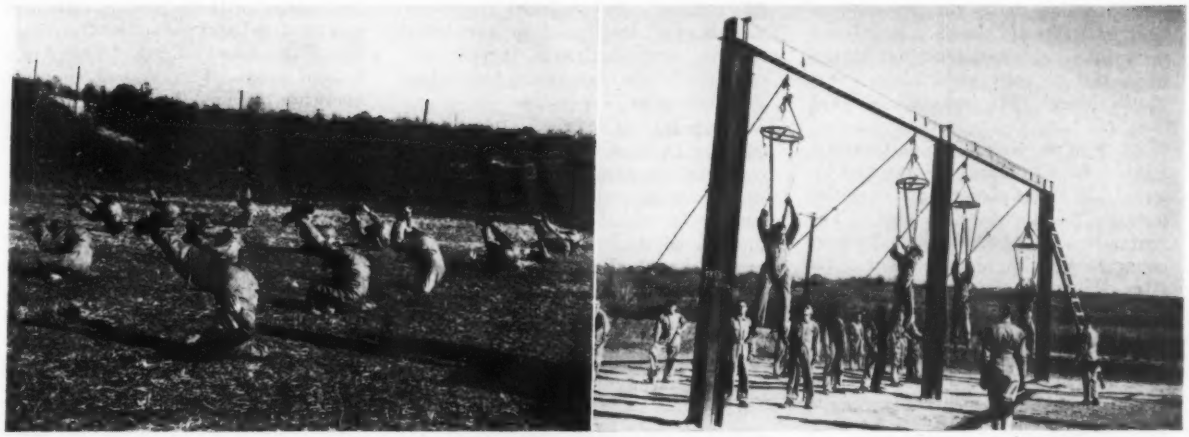
Personalities

Young America—1941 Model. Victor Shawe. A character sketch of a typical American young woman who is earning her flying time by working as an office manager-secretary at the Oakland Airport. *U.S. Air Services*. January 1941, page 13, 1 illus.

Airline Builder. An outline of the aviation career of Thomas Fortune Ryan, III, President of the Mid-Continent Airlines. *National Aeronautics*, January 1941, page 16, 1 illus.

Mlle. Instructor. A. D. Stuebing. An account of the flying career of Miss Helen Harrison, who until recently was teaching Canadian air cadets to fly. With 2,000 hours to her credit, much of it as an instructor in Africa and Canada, Miss Harrison still finds it hard to convince the Canadians that she deserves an instructor's job with the R.C.A.F. or a pilot's assignment with one of the Canadian airlines. *Flying and Popular Aviation*, February 1941, pages 49, 50, 87, 1 illus.

Smart Sergeant. Alexander McSurely. Career story of Sergeant Ralph Gray, an Army technician who has developed a hydraulic fuel system



Before actual jumps are made by candidates for the U.S. Army's new parachute battalions, now being trained at Fort Benning, Georgia, the troops are put through special drill to harden and prepare them for the rigors of this form of military tactics. Tumbling exercises are designed to train parachutists to withstand the shock of landing and to regain their feet rapidly. In the suspended harness trainer, parachutists are taught the manual technique of manipulating the parachute during descent.

which operates efficiently at any altitude. It is stated that the device eliminates vapor lock, and is being installed in many new airplanes being built for the Army. *Flying and Popular Aviation*, February 1941, pages 41, 79, 1 illus.

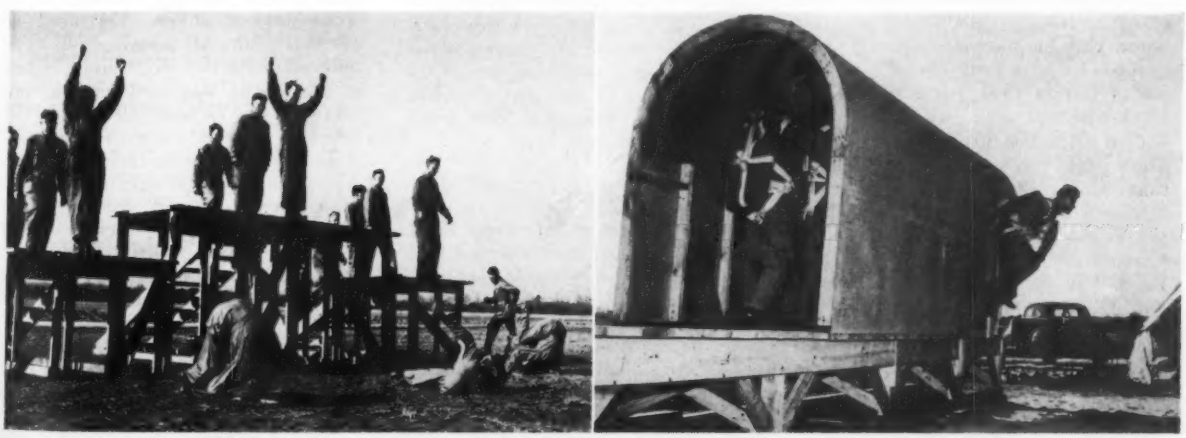
I Learned about Flying from That! Lieut. Robert L. Scott, Jr. This month's experience illustrates the importance of careful inspection and of never taking the condition of an airplane for granted. The writer's rudder control jammed at three hundred feet, on the take-off at full left position. Having slipped and skidded to a cross-wind landing in which the wind helped to compensate for the yaw, an examination showed that a faulty cartridge case receiver on the rear machine gun had permitted empty cartridges to drop into the fuselage and collect back around the rudder controls. Had a cartridge jammed the elevator control this article would probably not have been written. *Flying and Popular Aviation*, February 1941, pages 35, 78, 79.

Parachutes

United States Army Adopts "Vertical Envelopment" by Parachute Troops. Major Frank L. Nelson. The idea of parachute troops, like many other tactical innovations being used effectively in the present European war, was first conceived in the United States. In 1928, years before Soviet Russia started mass parachute descents for vertical envelopment, experimental work on parachute infantry was carried out at Chanute Field, Ill. Changes in military tactics indicated the need for parachute troops in the United States and resulted in the establishment of the 501st Parachute Battalion at Lawson Field, Fort Benning, Georgia. This article outlines the history and background of the battalion, outlines its duties and explains its course of training. Requirements for admission into this all-volunteer unit are also given. *U.S. Air Services*, January 1941, pages 10–12, 2 illus.

Private Flying

Hello, Alaska. Alma Heflin. A report of a light airplane tour of Alaska, made by two girls in a 65 hp. Cub. The article contains a description of the fields, terrain and maintenance facilities, as well as in-



Platform exercises correct the natural tendency to land on the toes rather than the ball of the foot. This drill accustoms the ankles and leg muscles to shock action. The last stage of ground training is the door "mock up" which teaches proper technique for rapid exit from the airplane during mass jumps.

teresting side lights on the uses of light aircraft in Alaska. Some observations on the defense of Alaska from the air are also made. *Air Trails*, March 1941, pages 23, 53, 54, 4 illus.

So You're Going Cross-Country. Robert W. Crawford. Notes and information about airports and facilities for the private tourist pilot. The writer is a singer who keeps concert engagements in his Rearwin. He cites the need for inexpensive accommodations for touring pilots, less tax on aviation fuel, and more low-cost transportation between the airport and downtown, especially where distances are considerable. *The Sportsman Pilot*, January 15, 1941, pages 10, 40, 42.

So You Want to Start a Flying Club. George R. Reiss. Suggestions for the organization and administration of a private flying club. Costs and dues are given, together with an outline of some of the problems involved. The writer believes that membership should be held to between ten and twenty persons for each airplane, and warns that great care must be taken in the selection of members. Other questions such as the choice and care of equipment and choice of instructor, are also discussed. *Flying and Popular Aviation*, February 1941, pages 22, 23, 66, 82–84, 3 illus.

High Flyin' Hector. Joseph W. Morgan. Flying activities of Hector, Minn., said to be the most air-minded town or city in the United States. It is claimed that 40 per cent of the men between the ages of eighteen and forty are either pilots or student pilots. The town has five airplanes, a very active flying club, and an airfield two blocks from Main street. None of its pilots or student pilots have ever had an accident, which they explain by saying, "We obey the rules." The town, airport, flying club, and equipment are described. *Flying and Popular Aviation*, February 1941, pages 32–34, 87, 88, 6 illus.

Civil Plane Production Reaches All-Time High. Review of 1940 production figures of the leading manufacturers of civil aircraft. Included are Piper, Taylorcraft, Aeronautical Corporation of America, Porterfield, Luscombe, Stinson, Waco, Rearwin and Cessna. Growth is attributed largely to the Civilian Pilot Training Program. *Aviation*, February, 1941, pages 50, 51, 3 illus.

Propellers

The Virtues of the Feathering Airscrew. L. B. Greensted. General discussion of feathering propellers. Advantages are outlined together with a brief description of how both electric and hydraulic types are operated. *The Aeroplane*, December 20, 1940, page 711, 1 illus.

Balancing of Aircraft Propellers. Murray C. Beebe, Jr. The first in a series on the elimination of vibration in aircraft propellers. The types and causes of unbalance in propellers, and the methods for correcting them are discussed. The Gisholt Dynetric balancing machine was used to determine the actual magnitude of the unbalance inherent to the hydromatic type of propeller. The manner in which this device was applied to these tests is described. *Aero Digest*, February 1941, pages 13, 14, 17, 18, 166, 5 illus.

Airscrew Spinners—A Difference of Opinion. K. B. Gillmore, Chief Designer, Airscrew Division of the de Havilland Aircraft Co. Ltd. Defense of the airscrew spinner with rubber mounting. It is stated that tuned flexible mountings are often the only means by which vibration and the attendant fatigue stresses can be avoided. Issue is taken on several points about spoked, cooling, and bulletproof spinners, made in the article "Airscrew Spinners," in the November 21 and December 5 issues of *Flight*. *Flight*, December 19, 1940, page 526.

Propeller Design Factors. Raoul J. Hoffman. Data for computing propeller thrust, diameter, pitch and hp. problems. *Flying and Popular Aviation*, February 1941, pages 57, 82, 1 illus.

Calcolo delle Frequenze di Vibrazione Flessionale di una Pala d'Elica in Rotazione (Calculation of the Frequencies of the Bending Vibrations of a Rotating Propeller Blade). E. Lorenzelli. A calculation method is described to determine the frequencies of the bending vibrations of a rotating propeller, with consideration of the area of the blade section, of the camber of the blade, and of the exact course of the moment of inertia. *L'Aerotecnica*, November 1940, pages 815–833, 3 illus.

Radio

Range Control at LaGuardia Field. David S. Little. The almost simultaneous arrival of scheduled air liners at LaGuardia Airport during instrument conditions created a "stacking up" of airplanes which sometimes caused considerably delay in landing. Ordinarily, the pilot of the transport airplane was in radio communication with his own company's station until he was in visual contact with the field. A new method for speeding up this delay was evolved; a system whereby the control of these landing airplanes is centralized and put under the direction of the Airway Traffic Control in a limited area. This system, now in operation at LaGuardia Airport, has cut the individual airplane landing time allowance from twelve to four minutes. *Aero Digest*, February 1941, pages 46, 48, 50, 5 illus.

Stress Analysis

Some Theoretical Consideration On Box Beams. Jean Drymael. Box beams, built up essentially with flanges and webs, are widely used in aircraft construction and much has been written about their calculation. Often assumptions are implicitly made without reason. This paper attempts to point out which assumptions must be chosen and why, and shows what results may be expected from them. Calculations are developed for cases of the quadrangular box beam and the wing with three spars. *Journal of the Royal Aeronautical Society*, January 1941, pages 5–28, 16 illus.

Shear Center of a Multi-Cell Metal Wing. H. W. Sibert. Simple formulas based on the least work of shear are given for the coordinates of the shear center and the shear force per unit length of arc of a multi-cell wing beam. The terms involved in these formulas are ordinary summations or can be evaluated by Simpson's Rule according as concentrated areas or skin effective in bending is concerned. A numerical example is worked out for the case of a two-cell wing beam with skin on the tension side effective in bending. *Journal of the Aeronautical Sciences*, February 1941, pages 162–166, 3 illus.

The Column-Strength of Closed, Thin-Walled Sections of 18–8 Stainless Steel. Howard W. Barlow. Thin-walled members having closed cross-sectional shapes are used as columns in aircraft construction. The purpose of the investigation described in this report was to determine and evaluate the factors influencing the behavior of such columns fabricated from 18–8 corrosion-resistant steel. Approximately 300 specimens comprising two different cross-sectional shapes in nominal thicknesses of 0.006 in., 0.008 in., 0.010 in., 0.012 in., 0.014 in. were tested as columns under flat-end and under pin-end conditions.

In order to carry out this investigation it was necessary to develop new methods which were found to have broad application.

Two new types of special fixtures were developed which permitted pin-end tests to be conducted with the use of flat-end specimens.

A simplified and improved technique was developed for testing the columns. This technique is superior to that currently employed which makes use of imbedding plates, of cast ends and of specimens subject to loading in prior test. The technique includes an improvement in the process of preparing the samples for test. *Journal of the Aeronautical Sciences*, February 1941, pages 151–161, 12 illus.

Warfare

Air Strategy—XXXI. Italy as a Target—III. Captain Norman Macmillan. A discussion of the importance of Italy as a military target. The meteorological problems involved in long distance raids on Italian objectives are discussed, also the necessity for making up a list of alternate targets, to be used in case fog makes bombing the spot for which the bombers first set out, impossible. The important bombing objectives at Turin, Milan, Trieste and other places are named and their locations described. *Flight*, December 12, 1940, pages 495, 496, 497.

Italy as a Target—IV. Captain Norman Macmillan. Present phase of the air war is discussed, together with the effect of shorter nights upon the bombing operations against Germany and Italy during the coming spring and summer. The writer believes that night raiding ought to be at a maximum now, as short nights in the northern latitudes will make it more difficult later on. Bombing objectives in the various target areas of Italy are also listed. *Flight*, December 19, 1940, pages 530, 531, 1 illus.

Italy as a Target—V. Captain Norman Macmillan. Effects of the British offensives in Africa and Albania are discussed. The writer believes that the principal advantages will be the reduction of Italian fighting strength, more British naval and air bases and better strategical positions to withstand German thrusts in the Mediterranean as well as gains in British prestige in Europe and America. However, he concludes that action on those fronts is by no means decisive and compares it to clearing away underbrush before being able to get on with the main job of felling the trees. Important bombing objectives in Italy are mentioned and again the suggestion is made that an "Air Blockade Command" be created for continuous bombing of German industrial centers. *Flight*, December 26, 1940, pages 543, 544, 1 illus.

Through Hell on Wings. Composite diary of several R.A.F. pilots, edited by Keith Ayling. This first installment describes an air engagement, the job of writing to the mother of a fellow pilot who was killed, and the daily life at an R.A.F. fighter squadron base. Mention is also made of the older men who serve as aircraft spotters. Described as a cold, miserable, monotonous job, it is said that sometimes the men have to be carried off duty, but they never miss their turn. *Liberty*, February 8, 1941, pages 8–13, 4 illus.

There never was any doubt in London that in the event of war the strong British navy was sufficiently able to assure a continuous supply of oil from abroad. This opinion was supported by the report of the Falmouth committee which investigated the eventual manufacture of mineral oil from domestic raw materials. The British Chemical Trust has a good sized plant at Billingham to manufacture gasoline by the coal hydration

British-Combine

Paternoster Row, London, after the night air raid which destroyed this historic book publishing and selling area. (*See Editorial.*)

Through Hell on Wings—Part 2. Composite diary of several R.A.F. pilots, edited by Keith Ayling. Part two describes combat with a twin-engined Messerschmitt fighter, troubles of the squadron's red-headed "cowboy," and the depressing effect of a letter of encouragement from home. *Liberty*, February 15, 1941, pages 14–17, 1 illus.

Angst um Oel in London. (Anxiety in London About a Sufficient Supply of Oil.) Dr. Walter Fleming. A German view of the alleged precarious position in which England finds herself in regard to a regular oil supply.

method, also a small plant in South Wales, but their maximum production represents about 1 per cent of the total consumption. The author believes, as conditions are now, that German U-boats and bombers will be able to sink enough oil tankers on their way to England to cut down the necessary supply. He refers to an article in the London "Petroleum Times" which criticizes the British oil policy, calls attention to the German coal liquefaction method, and to the fact that it would take England years to change over to the latter method.

Even if England has an unlimited

supply from every oil producing country, it is claimed that German naval warfare will see to it that such a flow is turned into a trickle. The writer believes that there is little chance of saving England from an oil famine. *Der Deutsche Sportflieger*, November 1940, page 221, 2 illus.

"Nobody's Baby." A member of the British Observer Corps describes some of the hardships and shabby treatment accorded this civilian branch of the air defense system. *Flight*, January 2, 1941, pages 11, 12,1 illus.

The Ghost of General Douhet. Cy Caldwell. A review of the application of the air strategy advocated by General Giulio Douhet in his book, "The War of 19 ." to the present struggle. Douhet advanced the doctrine, "Be stronger in the air than your enemy, and keep on fighting until eventually you wear him down to a point where you have some air power left, and he has none."

The article states that, in the so-called Battle of Britain, it was the lack of airports in France and Belgium, not any shortage of aircraft or pilots which hampered Germany's first invasion attempt. As the German military machine behind the Siegfried Line last winter worked to prepare for the Spring offensive, they have been preparing another drive during the last few months by intensive troop training and by using the labor of prisoners of war to build airports. The psychological factors operating on both the German army and the British Civilian populations and their effect on the final outcome of the war are discussed. *Aero Digest*, February 1941, pages 43–45, 196, 6 illus.

Taranto! A photographic account of the attack on the harbor of Taranto made by aircraft from the British aircraft carriers *Illustrious* and *Eagle*. Serious damage to cruisers, destroyers and capital ships are shown by aerial photographs. *War in Pictures*, December 1940, pages 2, 3, 6 illus.

War in the Air—Opinions From Overseas Pilots. Ronald A. Keith. British pilots offer data and lessons learned from recent air fighting. Opinions expressed include the following: that Stukas are easy prey to fighters, that Lockheed Hudsons and Avro Ansons have proven their military value time and again, that German pilots and equipment are of the very best, that German anti-aircraft fire is uncomfortably accurate even at night, and that damage of British bombing in Germany has been more severe than is generally known. Problems of night fighting and breaking up bomber and fighter formations are also discussed. *Canadian Aviation*, January 1941, pages 17–19, 36, 5 illus.

Victorious Fighters. Ralph Michaelis. A description of how a fighter squadron, on duty protecting the English coast, operates. The article gives an account of a night in the pilot's rest room, relating how the pilots receive their instructions, and the routine followed in their work. *Illustrated*, Royal Air Force Special Number, January 1941, pages 18–22, 13 illus.

More History in the Making. C. G. Grey. The writer suggests that bases on the northwest coast of Ireland which were once occupied by British, again be used as naval and air bases for the better protection of North Atlantic shipping lanes. He also discusses night raids over England and describes the effects of a bomb which landed in the middle of the street in front of his house. *The Aeroplane*, January 3, 1941, pages 16, 18, 3 illus.

Onslaught on Germany. Carl Olsson. An explanation of how an R.A.F. bombing raid on a German objective is planned, prepared and executed. Many people, according to the writer, believe that the bombing squadron merely flies to an approximate objective and drops its projectiles on a likely looking objective. This article outlines the method by which Military Intelligence gathers the information from previous reports or photographs, how operations plan the flight, and how the flight crew executes the "sortie." *Illustrated*, Royal Air Force Special Number, January 1941, pages 4–13, 17 illus.

Air Strategy—XXXV. The Fourth Dimension. Captain Norman Macmillan. Assuming that Germany will attempt an invasion of England in the spring, it is suggested that the way to defeat this offensive is to continually bomb Germany, troop concentrations, and barracks as well as factories, supply bases, etc. Time has become the most important dimension, important because it is the one dimension which militarists cannot control. It can, according to conditions, work as foe or as friend. The writer states that England can make up for her inferiority in manpower with her superior machine building facilities. Much of her help must come from across the seas, and, therefore, her shipbuilding program must not be blackened. The steel and other materials thus required, in turn, take away from tank and artillery manufac ture. The answer according to this article is to even the score by continuous aerial bombardment. *Flight*, January 9, 1941, pages 33–35.

Ballon-Versperringen (Balloon Barrages). A detailed observation of the advantages and disadvantages of balloon barrages such as used extensively in England. The writer concludes that balloon barrages are practical under certain conditions for certain places, but not for general use. *Luchtvaart*, November 5, 1940, pages 403–405.

"Archibald, Certainly—" During the first World War, the anti-aircraft gun was looked upon by many as a rather innocuous weapon. Technical developments such as the predictor have increased the accuracy of this weapon considerably. This article contains some surprising figures on the damage that the anti-aircraft batteries defending England have inflicted on the German Luftwaffe. The number of machines thus destroyed in 1940 totals 444. *Flight*, January 9, 1941, page 21.

German Mass Attack on Britain an Utter Failure. A photographic record of a spitfire squadron breaking up an attack on a British convoy. New pictures of German aircraft, recently shot down in England, are also published. *Neptune*, September 1940, pages 16–19, 21, 22, 27 illus.

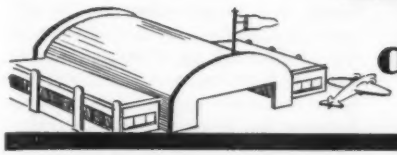
Bombs on Germany. A map, based on official British Air Ministry figures, showing the location and objectives involved in over a thousand bombing raids on Germany conducted by the Royal Air Force. Photographs and explanations of military targets at Harburg, Osnabruck and Berlin are also given. *War In Pictures*, December 1940, pages 8, 9, 4 illus.

Around Us the Wail of Sirens. Rebecca West. Description of life in England under bombing attack. Included is an incident showing the strain and misery which can be caused by having to take in a refugee whose only thoughts are those of derision and criticism. *Saturday Evening Post*, February 8, 1941, pages 27, 48–51, 53, 1 illus.

Welding

Welding of Airframes. W. S. Corns. First of a series of articles on aircraft welding. This one includes the additional skill and knowledge required for aircraft welding, a discussion of "locked-up" stresses, penetration, welding equipment, achieving non-stressed work, correction of bowing, testing for straightness, welding a star joint, and welding flame control. Tubular airframes are shown with the various joints involved in their construction, and the welding sequence of joint members is explained. *Aircraft Production*, January 1941, pages 21–25, 10 illus.

House Organs and Catalogues



Lockheed's Personnel Division

Human Relations. Royal W. Fraser. Six years ago, an aircraft factory mechanic who had been trying for two days to get an employment interview at the Lockhead plant contacted a newly hired publicity man by telephone. The man had written for an application and never received an answer. Finally he traveled to the factory, and then couldn't see the right person. The press agent, Randall Irwin, took it upon himself to take the man's address and tell him he would contact him soon. This irregularity was due to the fact that all the factory hiring, in those early days, was done by the chief pilot who tested airplanes, checked out other pilots, demonstrated and among other things, handled personnel. As a result, letters of application went unanswered and personal interviews were virtually impossible to get. Irwin asked the chief pilot if he could take over this chore. How the Personnel Department grew from a part-time job for a publicity man into one of the important sections of a great airplane factory, charged with securing and handling men for all types of work, is outlined in this article. *The Lockheed Aircraftsman*, January.

Fasteners and Flooring

Metal fasteners in aircraft are used for three general purposes, namely: outside fasteners to carry heavy loads or light loads in the airstream and inside fasteners for use inside the structure. This brochure describes four types of clips which cover all of these needs under almost all conditions, manufactured by Simmonds Aerocessories. The "P" and "R" type clips, adaptable to internal panel requirements, the type "T," used for flush installation on cowlings, etc., and the "F" type for carrying light loads are described.

A loose-leaf supplement to the regular pamphlets describes a non-slip flooring material which retains its traction even when wet or oily. This flooring, usable for wingwalks, flooring, interiors, etc., showed in comparative tests that it reduced drag and increased aerodynamic efficiency. *Simmonds Aerocessories, Inc.*

Plastic Windshields and Windows

Plexiglass. A description of Plexiglass, an acrylic plastic, one of whose many uses is that of aircraft windshields and windows. The chemical, physical and optical properties of the material are given and its application to airplane construction is outlined. Tables of optical, electrical, chemical and physical characteristics are included. *Röhm & Haas Company.*

Flight to Brazil

10,000 Mile Delivery Flight! Louis B. Bouchelle, Jr. Up until 1938, all aircraft purchased by the Brazilian government in the United States were crated and shipped by rail and sea. The manufacturer's responsibility ceased only when the airplanes were unloaded at their destination. This entailed a loss of time and money in crating, uncrating, delivery time as well as the tearing down and re-assembly of the airplanes. In 1938, the Brazilian government experimented with flyaway delivery by having part of an order flown to Rio de Janeiro while the rest went by boat as usual. The flyaway delivery was so successful that now all the airplanes are delivered under their own power. This article is an account of one of these delivery flights on which the South American representative of North American Aviation flew to Rio with a unit of Brazilian aviators under the command of Major Jose S. Macedo, while ferrying a flight of North American attack bombers to their bases in Brazil. *North American Skyline*, January.

Whirl Wing "Movie" Book

A Kinographic presentation of the "jump" take-off over an obstruction made by the Pitcairn "Whirl Wing" Autogiro. Utilizing the old "movie book" idea, twenty-eight pictures of the new Whirl Wing, taken at one-fifth second intervals, are bound together. By flipping the pages rapidly, the effect of motion pictures is achieved, showing the rapidity and steepness of climb possible in the new rotating wing craft. A technical description of the new craft is also included. *Pitcairn Autogiro Company.*

Reports from England

Our Wings and Views over England. Reports of the performance of American-built airplanes fighting in England, the condition of civilian morale and actual flying conditions, sent to the Douglas Airview by Henry H. Ogden, one of the original U.S. Army round-the-world fliers who is in charge of assembling U.S. aircraft in England, and Bert Williams, brother of two Douglas employees, who is connected with an aircraft component builder near Manchester.

According to these statements, the Germans are using pattern bombing, hoping to fracture civilian morale, while the R.A.F. bombers strike at particular objectives for the purpose of crippling industry, disrupting supplies and communications, thus forestalling the impending invasion attempt. Reports from France, Belgium and Holland show that bands of young boys and girls, from 10 to 17 years of age, are organizing into guerrilla bands and damaging communications and supply lines. An account of an air battle in which a large formation of Dornier bombers were destroyed, described in an R.A.F. pilot's letter to a friend in the Douglas plant, is also printed. *Douglas Airview*, January.

Monel Tips for Wooden Propellers

Protection for the Plane Propeller. Monel metal has been found to be most satisfactory for sheathing the leading edges and tips of wooden propellers according to Sensenich Brothers. The method of cutting and applying it with Monel screws is described. The International Nickel Co., *Inco*, December.

Training at Parks Air College

Eaglets Earn Their Wings. Parks Air College, at East St. Louis, in addition to its capacity enrollment of 315 students, will give primary instruction to more than 1,000 Air Corps flying cadets this year. This article outlines the five weeks' course given to Army students and the 96 and 108 week courses in flying and various ground professions given at Parks. The equipment, the curriculum and the "student air line" are described. *Shell Progress.*

The Story of YSAT

Speeding the Yukon Mail. J. Harper Prowse. The history of Yukon Southern Air Transport, Ltd., one of the three airlines to link Nome, Alaska, with the Eastern seaboard, is an exciting adventure in commerce. Unlike many other lines serving the North country, this line, in its early days, received no aid from government agencies or influential and well established parent organizations. YSAT began service six years ago with two J5 Fokker monoplanes which had already seen considerable service flying hunters, prospectors and frozen fish from the lakes to the railroad sidings.

This article outlines the growth of the line from the humble beginning to the largest independent airline in Western Canada. This line was the first in this area, according to this article, to use two-way voice radio, to put their flight crews into uniform, and to adopt twin-engined equipment. *The Intava World*, December.

Edsel Ford Visits Douglas

New Production Horizons. An account of the visit to the Douglas plant made by Edsel Ford, President of the Ford Motor Company. This visit is the forerunner of a mass production plan for four-engined bombers in a co-operative effort between motor car and airplane manufacturers. The article also explains the sub-contracting system which has been built up to provide pre-fabricated parts and sub-assemblies for mass production of bombers and other defense aircraft. *Douglas Airview*, January.

New Airplane Location Recorder

United Air Lines announces successful tests of an automatic airplane location recorder which registers the bearing of the airplane from the ground station every time it reports by radio. A cross-bearing from another station gives a radio "fix" and the device is said to give a warning if the airplane is off course. *United Air Lines News*, January.

Fairchild CG16 Machine Gun Camera

Description of the Fairchild machine gun camera used for training purposes. Designed to simulate the size, weight and feel of the regulation Browning or Colt machine guns, it uses 16 mm. motion picture film, and "fires" through a glass plate on which are engraved the concentric circles and cross hairs which serves to check the accuracy of the "burst." Time and duration of fire can be photographed on the film. Various optical elements are also listed. *Bausch & Lomb Magazine*, January.

Cub Pilot Rescues Hunters

Cub Rescues Many in Midwestern Blizzard. A recent blizzard, sweeping suddenly down onto the midwest, trapped hundreds of duck hunters. Winona, Minnesota, was in the midst of one of these hard-hit areas. Despite the 40–50 m.p.h. wind and almost unflyable weather, Max Conrad, intrepid Cub dealer, patrolled the bottom land in his neighborhood, spotting stranded hunters, dropping food and directing searching parties. This article contains an account of Conrad's heroism, told by one of the hunters whose life he saved. *The Cub Flier*, February.

Flight Commander's Story

"It's Not a Life of Reilly." Captain R. M. Montgomery. A Flight Commander at the U.S. Army Air Corps Training Center at Randolph Field explains the relation between himself and the sixty cadets for whose instruction he is responsible. The article indicates that the man who must, in a large measure, pass judgment on the flying ability of future Army pilots, does not always have an easy or pleasant job. U.S. Army Air Corps, Randolph Field, *Form One*, February.

The Wenner-Gren Aeronautical Research Laboratory

Details of layout, construction and purpose of a new aircraft engine research laboratory at the University of Kentucky. Undergraduates will be taught the laboratory procedure used in aircraft engine plants. Several other universities may cooperate in a part-time exchange of students. It is stated that during the emergency short intensive courses will be given to supply the industry with needed manpower. Construction, sound-proofing, ventilating system and the layout of test and control rooms are described, in addition to the various types of test equipment. *The Kentucky Engineer*, December.

Central American Air Freight

TACA: Gold Express. Ralph Hancock. Gold mines, hidden in the dense jungles of Central America, are weeks from their coastal bases of supply when they depend on shallow river boats, mules and ox carts. By air, they are only a few hours away. Transportes Aereos Centro Americanos, familiarly known as TACA, has provided freight service for many of these inland enterprises at a rate that competes with any of the primitive methods of transportation. How TACA carries 15,000,000 pounds of freight in a single year, making good their statement that they could deliver any article they could load, is told in this report. *The Intava World*, December.

Straight-Line Production at Douglas

For Aerial Security—Streamlined Production. With the rearmament drive moving into high gear, Douglas, like many other plants engaged in building military aircraft, is faced with the problem of building many airplanes where one was built before. Increasing floor space was not enough. The expanded factories had to be scientifically utilized for the highest possible production.

This article explains the progressive arrangement of production, which permits the smooth movement of materials, fabricated sections and sub-assemblies to the main assembly line. The history and progress of this plan of factory layout is reported in this article. Some of the new machinery for rapid production is also described. *Douglas Airview*, December.

Cold Starting

The problem of starting cold aircraft engines is being studied continuously at the Intava laboratories in England in a set of refrigerated chambers in which the temperature can be controlled to −10°F. The important thing in starting in cold weather is to provide a proper initial mixture to insure instant ignition when the engine is turned over, and to develop enough power to keep the engine running during the warming up period. The dilution of the lubricating oil before the engine is shut off, a method developed for cold weather operation by the U.S. Army Air Corps, is described. *The Intava World*, December.

New Course in Meteorology

The Spartan School of Aeronautics has announced the introduction this spring of a twelve months' course in Air Mass Analysis and Weather Forecasting. In order to prepare graduates for positions as airline meteorologists, U.S. Weather Bureau observers and forecasters, and commercial meteorologists and instructors, a complete observatory, equipped with the latest instruments and radio-teletype communication channels, has been provided. *Spartan School News*, January.

Proof-Testing at Consolidated

Load proof-testing of large wings at Consolidated is done by means of hydraulic rams which apply controlled loads upon any or all portions of the wing simultaneously. This method has been substituted for the short bag loading method for reasons of better control, speed and simplicity, as well as the fact that large wings can be deflected to a point where there is danger of shot bags shifting or slipping completely off the wing. The testing method and equipment are described. *Consolidator*, January.

New Factory Taking Shape

Bombers by the Acre. A description of the new Douglas Aircraft plant at Long Beach, California, whose construction is rapidly being completed. The new factory will cost $12,000,000, provide 1,400,000 sq. ft. of working space and house over 20,000 employees.

Among the unique features is a "blackout" arrangement of the factory. It will have neither windows nor skylights, making it invisible at night, while for day concealment the flat roof will be colored to match the area and blend with the landscape. The ventilation and lighting system is explained in this article, which outlines the history and progress of this newest branch of Douglas. *Douglas Airview*, January.

Biography of British Pioneer

An account of the aviation career of Eric Cecil Gordon England, managing director of General Aircraft, Ltd., builders of the Cygnet and the Owlet, tricycle undercarriage airplanes. His first job was managing an early flying field. His early adventures as a test pilot are outlined, as is his wartime and post-war career. *General Aircraft News.*

Aircraft Instrument Handbook

Descriptions, specifications and installation instructions for aircraft instruments built by the United States Gauge Co. The gages described employ either the diaphragm or the bourdon tube principle. Included in the handbook are airspeed indicators, manifold pressure gages, engine gage units as well as various types of pressure, suction and fuel quantity gages. Several types of thermometers, an ice warning indicator and warning units to safeguard against drops in fuel and oil pressure are also described. *United States Gauge Co.*

Cleaning Aluminum

Method of Preparing Alumimum for Spot Welding. A special field service report on a new method of cleaning aluminum preparatory to spot welding. In order to do this successfully, the metal must first be free from all grease, oxide, identificational paints, etc. This may be accomplished either by mechanical scrubbing or by chemical dipping. Formerly, the dipping solution was a 2 or 3 per cent solution of hydrofluoric acid. Due to the extreme activity of this reagent, this method had certain undesirable features. An efficient substitute for this reagent has been found in a solution of Oakite Composition No. 30. The method and advantages of this cleaning agent are outlined. A work diagram covering common examples in aircraft production is also provided. *Oakite Products, Inc.*

Mass Production of Airplanes

Engineering Considerations in the Application of Automobile Methods to Aircraft Production. Don R. Berlin and Peter F. Rossmann. Aircraft production, until recently, was conducted on a small quantity production basis. Compared to automobile building methods, airplane production was slow, expensive, and sometimes cumbersome, due to frequent changes in design as well as to the small units of demand.

The international situation has created a need for mass production of fighting aircraft, and the airplane builders have begun to apply mass production methods, following as closely as possible the precedent set by the nations' automobile manufacturers. This article outlines the product and tool engineering, cost analysis, and regulation and production control which must be followed if mass production in aircraft is to be achieved. This article is a condensation of a paper read at a recent S.A.E. meeting. A series of articles on the same subject is being printed serially in *Aviation*. *North American Skyline*, January.

U.S. Light Engines

American Small Engine Development. The production of light opposed four cylinder engines for private and training airplane has risen from 800 in 1936 to 3,400 in 1939, and is expected to have doubled that number in 1940. This article contains a description and the development history of the Continental, Franklin and Lycoming engines, indicating their similarities and differences, and relating the problems involved in their growth. *The Intava World*, December.

Biography of Thomas A. Morgan

Sperry—Success Story of Science. On outline of the career of Thomas A. Morgan, who rose from an apprentice electrician in the U.S. Navy to the presidency of the Sperry Corp. *Douglas Airview*, January.

Inspection by X-Ray

The use of X-ray to determine the fitness of material and components for use in aircraft construction was first introduced as an experiment by Triplett & Barton in the Lockheed plant five years ago. In the beginning, only ten per cent of the material—the stressed parts—were X-rayed. Since that time, experience proved the wisdom of submitting all material to the searching eye of the X-ray. This article contains a description of the specially built machinery by which this unique method of mass inspection is accomplished. *The Intava World*, December.

Plant Storage System

A new catalogue on the Stackbin System of plant storage, designed to improve storage and handling of materials. The Stackbin system uses open-mouthed steel boxes of various sizes, which may either be stacked into each other, leaving the contents accessible through the open mouth, or placed into racks for individual handling. These units may also be set up in sections for convenient loading onto hand trucks. Tote trays, machinists' benches, box trucks and other shop equipment manufactured by this company are also described. *Stackbin Corporation.*

Alaskan Forced Landing

Down on the Sloko. Al A. Adams. An account of the rescue of a group of air passengers whose airplane had been forced down on the banks of the river Sloko in the mountains of Alaska during the winter of 1939, as related by Mike Gray, now the chief of Materiel division at Douglas. Gray was traffic manager of Northern Airways, owners of the airplane. The article is a thrilling account of the rescue of the passengers from the blizzard-swept, boulder-strewn river bank. *Douglas Airview*, December.

Preventing Corrosion

Anodizing. Bert Naseef. Description of the anodizing process at Consolidated. Includes a discussion of materials treated, effects of treatment and methods used. *Consolidator*, January.

Factory Operation

The Birth of a Panel. A picture survey of the creation of one of the many metal panels which make up the modern airplane. The building of the pattern, the preparation of the sand mould, the casting and finishing of the dies as well as the actual stamping and finishing of the component are illustrated. *General Aircraft News.*

R.A.F. Lockheed Repairs

"We Will Not Fail Them." An R.A.F. mechanic, assigned to a maintenance depot which overhauls and repairs Lockheed Hudsons used to patrol the North Sea area, relates a few of the humorous and difficult happenings at his station. Some of the problems in interpreting American nomenclature, which in some cases differs from the English, are outlined. The article also contains a description of several cases where work under pressure put badly crippled airplanes back into service in an amazingly short time. *The Lockheed Aircraftsman*, January.

(*Continued on page 35*)

News Review

January 10. Rear Admiral John H. Towers told the House Naval Affairs Committee that many Army, Navy and Marine Corps pilots now flying for commercial air lines would be called in for active duty by July 1st.

January 11. The All-American Air Maneuvers opened in Miami.

January 12. Dr. George Mead, aircraft production head of the National Defense Advisory Commission, in an interview, declared that a production partnership was being formed between aircraft and motor car manufacturers to facilitate increases in production. Ford, General Motors, Chrysler, Consolidated, Douglas and Martin were the companies involved.

January 12. American Export Steamship Lines placed equipment aboard all vessels plying between New York and Lisbon for upper air meteorological observations. These data will be used for the company's transatlantic service which is scheduled to start next summer.

January 13. United Air Lines flies 2,500 pounds of duralumin to the Lockheed plant at Burbank, California, from Pittsburgh in 14 hours and 33 minutes. Ordinary freight time would be about ten days.

January 13. Dr. Louis H. Bauer was selected to receive the John Jeffries award for his contributions to aeronautical advancement through medical research. Dr. Bauer was the first commandant of the School of Aviation Medicine of the U.S. Army Air Corps, and also the first medical director of the aeronautics branch of the Department of Commerce.

January 14. Professor Thorndike Saville announced a new graduate course in aircraft production at the Washington Square Center of New York University's College of Engineering.

January 14. The Curtiss-Wright Corporation announced a seven per cent salary increase for employees of its propeller division at Clifton, N. J.

January 16. A representative of the Aluminum Company of America declared that there was no general shortage of material for aircraft, and that his company would be able soon to provide all the metal necessary for the 3,000 airplanes per month program outlined for the U.S. by the National Defense Commission.

January 16. Col. J. Carroll Cone, manager of the Atlantic Division of Pan American Airways, was promoted to the position of Assistant Vice-President.

January 17. The Toronto Star reported that the Canadian Pacific Railway purchased three airlines: the Yukon and Southern Air Transport, Ginger Coote Airways and the Mackenzie Air Service. The report also stated that negotiations to purchase Wings Ltd., Airways Ltd., and Starratt Airways had been begun.

January 17. Under-Secretary of War Robert P. Patterson announced the establishment of an all-negro pursuit squadron for the U.S. Army Air Corps. Cadets will be chosen from those completing the C.P.T.P. secondary course.

January 18. Berths, carpets and other luxury fittings were removed from Pan American Airways transatlantic flying boats in order to increase their carrying capacity by 4,000 pounds.

January 18. Secretary of State Cordell Hull announced that a landplane as well as a seaplane base would be established on St. Lucia, a British Caribbean island. The base is almost within sight of French-owned Martinique.

January 18. John Owens, labor conciliator for the Defense Commission, asked Defense Director William S. Knudsen and Army and Navy heads to use their influence to persuade the aviation industry to sign an industry-wide labor agreement.

January 19. Buick Division of the General Motors Company received a War Department contract for $36,497,520 worth of airplane and engine parts.

January 19. Henry G. Houghton, Jr., assistant professor of Meteorology at the Massachusetts Institute of Technology, was chosen by the Institute of the Aeronautical Sciences as the recipient of the Robert M. Losey Award for his contribution to aeronautical meteorology in the development of an artificial method for dispelling fog.

January 21. Brigadier General Fredric Erastus Humphreys, the first U.S. Army pilot, died of a heart attack at Miami Beach at the age of 57.

January 21. C. E. Wilson, President of General Motors, announced that his company would be able soon to produce 1,500 engines and subassemblies for 200 airplanes per month.

January 22. Four-day "Air Raid" test, using the cooperation of civilian airplane spotters, began in the New York-Boston area.

January 23. Pan American Airway's Atlantic Clipper made a record flight of 16 hours and 44 minutes between Bermuda and Lisbon.

January 23. The House of Assembly at Hamilton, Bermuda, approved the 99-year lease of Tucker's and Morgan's Islands for U.S. Naval Air Stations.

January 24. Brewster Aeronautical Corporation announced plans for the immediate construction of a $5,000,000 plant in Bucks County, outside Philadelphia, Pa.

January 24. Puerto Rico's first Distinguished Flying Cross awards were bestowed on Captain Willard W. Lazarus and Sergeant William F. O'Malley. They stayed with their airplane when the engines failed while flying over mountainous country, while four other members of the crew took to their parachutes. Lazarus and O'Malley landed safely in a cane field.

January 27. The Buick Division of the General Motors Company announced that it will build a $31,000,000 plant to produce 500 Pratt & Whitney engines a month at Melrose Park, a suburb of Chicago.

January 27. U.S. Army Air Corps opened a drive for 16,600 volunteer recruits.

January 27. Air Corps school for high altitude flying opened at Wright Field, Dayton, Ohio.

January 28. The Aeronautical Chamber of Commerce of America announced that the United States produced $544,440,000 worth of airplanes in 1940, doubling 1939's amount.

January 29. A gift of several thousand etchings, engravings, bookplates and sheet music dealing with aviation to the Aeronautical Archives by Mrs. Bella C. Landauer of New York was announced at the Honors Night Dinner of the Institute of the

Aeronautical Sciences. Annual awards for achievements in aviation were made to the following: The Sylvanus Albert Reed Award to Dr. Hugh L. Dryden; The John Jefferies Award for Aeronautical Medicine to Dr. Louis H. Bauer; The Robert M. Losey Award for meteorology to Henry G. Houghton; The Daniel Guggenheim Medal for notable achievement to Glenn L. Martin; The Octave Chanute Award for outstanding contribution to the aeronautical sciences by a pilot to Howard Hughes; and The Lawrence Sperry Award for outstanding aeronautical work by a young man to Dr. William Bailey Oswald.

January 29. The Work Projects Administration approved the allocation of $245,533 for the development of a military airport at Fort Wright, Fishers Island, off the tip of Long Island in New York.

January 31. The Directors of Pan American Airways approved a pension plan to affect all their employees within the United States and in forty-nine foreign countries.

February 2. Col. John H. Jouett, President of the Aeronautical Chamber of Commerce, told the annual meeting of the American Institute of Banking that aircraft production in the U.S. was "hitting its stride," and would be able to provide an ample number of aircraft for both the United States and England by 1942.

February 3. U.S. airlines, facing a pilot shortage because of the number of reserve pilots among their personnel, asked to have Army and Navy officers assigned to their craft as co-pilots as advanced training for the service pilots.

February 6. Northwest Airlines announced plans for a new route from St. Paul to Fairbanks, Alaska.

February 7. Captain W. T. Hudnell, Jr., was named to receive the Distinguished Flying Cross for his heroism last April. While on an aerobatic flight during maneuvers at Langley Field, Captain Hudnell's controls jammed. Nevertheless, he remained with his craft, landing it safely and averting possible loss to civilian life and property.

February 7. Officials of the Ford Motor Car Company confirmed the rumor that a new technique for riveting duralumin had been developed which would speed up aircraft production and make Ford's prediction of 1,000 airplanes a day possible.

February 8. Continental Air Lines received the first flush riveted airplane in commercial use in the United States. The new craft, a Lockheed Lodestar, is 12 m.p.h. faster than the same design with conventional riveting.

February 10. Boeing B-17 D four-engined bomber was announced by the Army Air Corps. The new craft is equipped with self-sealing tanks, armor, retractable power turrets and increased fire power.

House Organs and Catalogues

(*Continued from page 33*)

Rebirth of an Air Force

A few miles outside Toronto, Canada, over a thousand Norwegians, who have fled the German occupation of their homeland, are rebuilding the Norwegian Air Force with which they hope to aid in regaining their national freedom. This article recounts the heroic effort the Norse airmen made to stave off the German invasion and the dogged persistence they have demonstrated in getting to Canada where they organized their own flight training center in a few months. *Douglas Airview*, January.

Airplane Engines from Automobile Plants

An explanation of the differences in production between automobile and aircraft engine production, indicating the changes in methods and workmanship which must be made in the automotive factories which are attempting to produce aircraft engines. *Automobile Facts*, January.

Bomber Assembly Plant Announced

North American Aviation, Inc., will manage a new assembly plant, covering over a million square feet of floor space which will be built and owned by the U.S. Government at Fairfax Airport, Kansas City. The proposed plant will assemble North American B-25 medium bombers from parts fabricated by the automobile industry. Local educational authorities are cooperating in a program to train the 10,000 to 15,000 skilled workers needed to operate the factory.

The article contains details of space distribution and a description of the proposed structure. *North American Skyline*, January.

Executive's Biography

Skyline Silhouettes. A biography of Noble Shropshire, contract administrator of North American Aviation, Inc. Shropshire, who learned to fly during the first World War, worked for Fokker Aircraft, the ancestor company of North American, and has been with all of the descendant organizations ever since. *North American Skyline*, January.

Instrument School Booklet

The American School of Aircraft Instruments in Glendale, California, has issued a new booklet explaining the increasing part that instrument technicians are playing in aircraft operation. The work such skilled mechanicians are being called on to perform, their future opportunities in aviation and the course of training given by the school to prepare candidates for this career are outlined.

Radio Tubes and Air Safety

Life Preserver for 2 Million People. An informal discussion of the part that radio has played in air safety and the role that vacuum tubes have performed in airplane-to-ground communication. The manner in which the problem of multifrequency transmission was solved for airline operation is outlined. *Eitel-McCullough, Inc.*

New Gear Catalogue

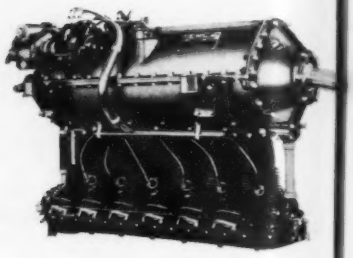
The 1941 catalogue on stock gears, sprockets and chains, reducers, bearings, and couplings recently issued by the Atlantic Gear Works includes specifications of pinion rods, racks, rachets, internal, special, helical, worm, bevel and mitre gears and similar products. A special supplement is attached listing types of equipment now available for special work. *Atlantic Gear Works.*

Randolph Grows On

A photographic record of the growth of Randolph Field, from the time the land was first turned over to the Army twelve years ago, up to the present. U.S. Army Air Corps, Randolph Field, *Form One*, February.

Cub Goes to "War"

Cubs Used Successfully in Army Operations. A Piper Coupe and Cruiser were used for military service by National Guard units on maneuvers near Camp Beauregard, Alexandria, La. The craft were used to direct artillery fire, for liaison and certain types of reconnaisance. Due to the low altitude at which the airplanes operated, it was found that they were virtually immune to anti-aircraft fire. *The Cub Flier*, February.



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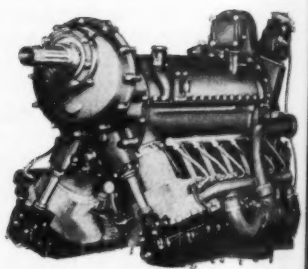

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From the Industry

Releases are printed as received from companies and other aeronautical organizations and the responsibility for the accuracy of all statements is therefore not assumed by the Aeronautical Review.

Civil Aeronautics Administration

Accident insurance premiums to cover students in the Civilian Pilot Training program have been reduced again, in effect, because, effective January 1, 1941, the amount of hospitalization and medical reimbursement has been doubled by the underwriters with no increase in the premiums, Col. Donald H. Connolly, Administrator of Civil Aeronautics, said recently.

The New Year "present" from the insurance companies is an increase to $1,000 of the reimbursement for hospitalization and medical care carried by all student pilots taking the C.A.A. preliminary course. The amount formerly was $500, and the increase will not increase the premium, which costs $9 for the course, including both the $1,000 for injury and $3,000 for death.

This action, Colonel Connolly said, represents the fourth voluntary concession by the underwriters during the less than two-year existence of the program, because of its unprecedented safety record.

Previous to the program, $3,000 coverage cost a student pilot $35. The first rate for the C.A.A. controlled course was $20. This was cut to $14 in the autumn of 1939, to $10 last June, and to $9 in September. Now the amount of injury-coverage is doubled without additional cost.

Aeronautical Chamber of Commerce of America

American aircraft manufacturers will be turning out 1,500 military airplanes a month by the middle of the current year—a task which but a few months ago appeared to be an utter impossibility—Colonel John H. Jouett, President of the Aeronautical Chamber of Commerce, declared in a recent radio address.

All leading American combat plane types now being delivered to our army and navy are provided with armor, leak-proof fuel tanks and fire power unsurpassed by planes operating in the European war theater.

"The aircraft manufacturers have been given the biggest job ever handed an industry," Col. Jouett declared. "This job is to build 37,000 military airplanes for the United States and Britain. Last fall a production goal of 1,000 military planes in the month of January 1941 was set by government officials. This figure was set despite the industry's sincere belief that that goal was far too optimistic considering available facilities. Last December a high government official estimated that the industry would fail to meet its goal by 30 per cent.

"But it gives me great satisfaction to announce that the aircraft industry has done the impossible asked of it. Plane production in November was around 700; in December, 800; in January, 1941, over 1,000."

America's latest fighting airplanes can out-perform German and British combat craft, in the opinion of observers who have just returned from England.

Cold statistics back that opinion and add weight to the recent evaluation of Yankee bombers and fighters by Lord Beaverbrook, British minister of aircraft production, who said: "They are magnificent aircraft!"

In the heavy bomber class, the later American models are far superior to anything the British or the Germans have displayed in action. Bombers of the Boeing B-17 series and the Consolidated B-24's—both four motored—illustrate this superiority, with their combination of long range, large bomb load and high service ceiling. They will meet Britain's need for bombers which can carry heavy gasoline loads for the long raids into Germany, and still reach the objective with a large bomb load.

In the field of combat planes, American models compare favorably with the best of the British and German pursuits. All speeds given here are those of the American Aviation Writers Association, noted for its conservative performance appraisals.

America's leading fighters and their speeds include: Curtiss P-40 (360 m.p.h.); Bell Airacobra P-39 (385 m.p.h.); Lockheed P-38, twin-engine (390 m.p.h.); Vought-Sikorsky XF4U-1 (400 m.p.h. plus).

These airplanes are faster than the leading German models, which include: Messerschmitt (360 m.p.h.); Messerschmitt 110, twin-engine (370 m.p.h.); Heinkel 112 (360 m.p.h.); Focke-Wulf 187 (360 m.p.h.).

And the American ships are faster than the British: Hurricane (336 m.p.h.); Spitfire I (365 m.p.h.) and Spitfire II (385 m.p.h.).

Manufacturers Aircraft Association

Samuel S. Bradley was re-elected chairman of the board of the Manufacturers Aircraft Association at the annual meeting held here today. Frank H. Russell will continue as president and John A. Sanborn was re-elected general manager. The Association administers the patent cross-licensing agreement for the airplane industry in the United States.

Mr. Russell stated in his annual report:

"A succession of unpredictable events in this country and abroad have had a profound effect upon our aircraft industry during 1940. The largest armament program ever undertaken in the United States has resulted in the expansion of our productive facilities at a rate heretofore unparalleled in the industrial history of any nation.

"Despite deliveries during the last twelve months which have been almost equivalent to the combined total for the preceding four years, unfilled orders today are nearly five times as large as a year ago. Productive floor space has already been increased to approximately twice the former area and in all probability will be doubled again during the coming year. Payrolls which have been

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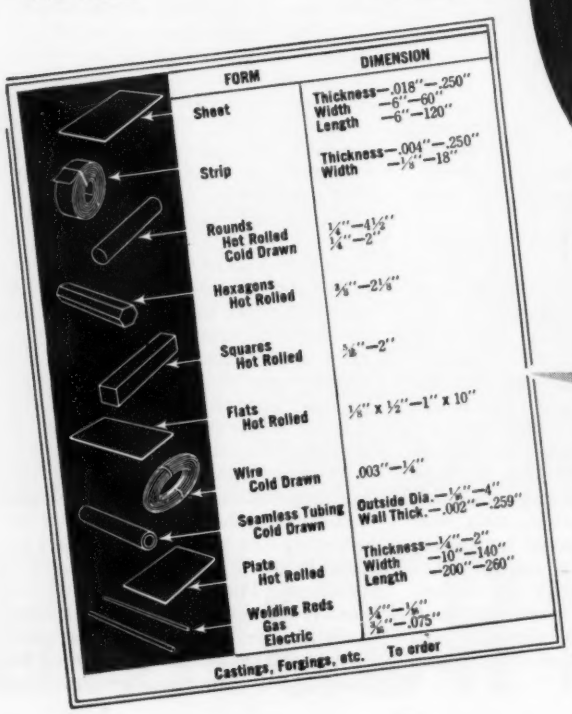

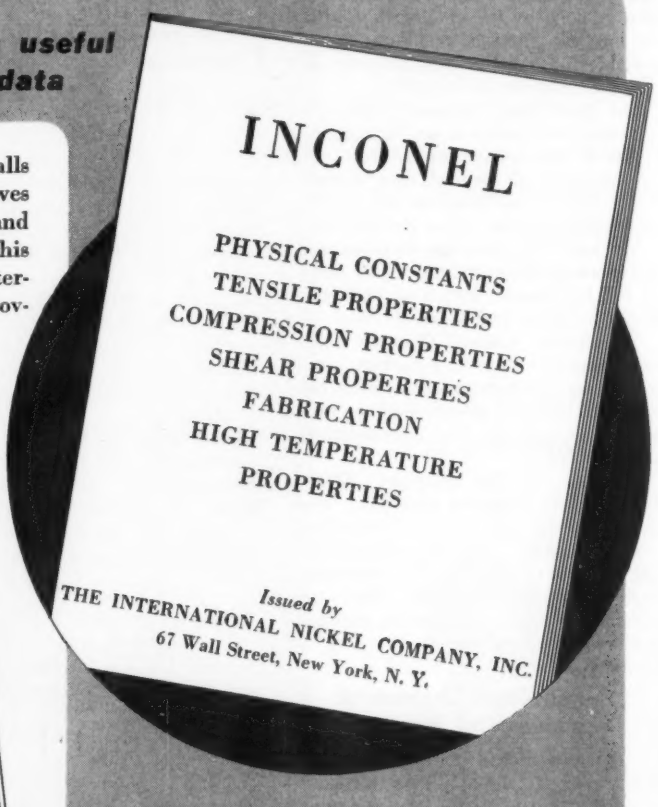

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increased fivefold since 1939 may soon include a half million employees and the aircraft industry will become one of the largest employers of factory labor in the country. This still is by no means an accurate indication of production capacity, as the latter may be expected to expand at a much faster rate due to the adoption of improved manufacturing methods, shop tooling and equipment, as well as the steps already taken to sub-contract a steadily increasing proportion of airplane parts.

"The past year has also found the industry capable of continuing our leadership in basic research and design. The latest models of American military aircraft rank with the best in the world and in most classes are already superior to those produced in other countries. Our commercial airplanes have far outdistanced those of our closest competitors.

"With reference to the more immediate affairs of the Association, it has become increasingly apparent that much of the progress made during the past year may be attributed to the soundness of the principles underlying the Cross-License Agreement. There has been no delay due to patent controversy within the aircraft industry. All manufacturers have been free to apply the most advanced ideas to current models without the necessity for protracted negotiations to obtain the right to use essential inventions and without fear of any interference from wasteful litigation. By continuing to make important technical progress available to all manufacturers, we have encouraged engineering and research while completely eliminating the possibility of any monopolistic tendency within the industry. At no time since the Association plan was adopted more than twenty-four years ago, has the practicability and importance of the Gross-License Agreement been more generally recognized than during the last twelve months.

A total of 1,110 patents have now been brought under the operation of the Cross-License Agreement. The membership of the Association includes practically all manufacturers of aircraft in the United States.

National Aviation Training Association

Increased training programs by both the Army and Navy air corps may open opportunities in those services for young men who do not have college training. Reports from Washington indicate that the two aviation services may begin accepting non-college men. Present requirements are that an air corps prospect must have at least two years of college credits.

Rear Admiral J. H. Towers, Chief of the Bureau of Aeronautics, Navy Department, testified recently at a Congressional hearing that the Navy was studying a proposal to create the "aviation pilot grade" in the Naval Reserve. He said he saw no necessity for a fighting pilot to be an officer. He testified that about 20 per cent of the Navy's pilots now are enlisted men. However, present requirements for flight-training enlistments are two or more years of approved college work.

Major Gen. H. H. Arnold, chief of the U.S. Army Air Corps, was quoted in a press-service story recently as expressing doubt that the army's standard of 2-year college requirement for air corps enlistment could be maintained, in view of the rapidly increasing demand for trainees.

If the military air services lower their educational requirements for pilot enlistments, then a large proportion of the students in non-college connected classes in C.A.A. flight-training would immediately become prospects for military enrollment. Physical tests would remain the same, according to views expressed in Washington.

New York Museum of Science and Industry

The Crowell Ground Trainer, which daily visitors are trying out at the "America's Wings in the Making" air show at New York Museum of Science and Industry in Rockefeller Center, is a unique machine invented by John Crowell for basic ground instruction in flying. It gives the fledgling flyer practice on the ground in the various control movements necessary to pilot an airplane in flight. Crowell, who has been flying for 20 years, and who has invented a number of special devices for airplanes, declares that use of the "trainer" cuts actual time in the air for flight training by at least 10 per cent, in that it enables the student to master the rudiments of flying before he starts his air instruction.

The "trainer" weighs 350 pounds, is portable, stands 46 in. high, and is of all-metal construction. Electrically powered, it can be put in operation on any hard, smooth surface. The chair seat is set on a rounded base of heavy casting and cannot turn over, permitting tilts in any direction. Manipulation of the controls stick and rudder bar on the "trainer" enables practice in turns, banks and level flying. A special light beam, synchronized to the "trainer," focuses on a large wall chart to show how well a pre-arranged course is being followed.

General Motors Corporation

C. E. Wilson, President of General Motors Corporation, recently announced completion of arrangements for extensive additional participation of the Corporation in the aviation defense program, calling for preparation to produce parts and sub-assemblies for 200 twin-engined bombers monthly and for increasing airplane engine production by 500 engines monthly to a total of 1,500 a month. This will involve an increase in the Corporation's employment, as the program reaches a peak, to 40,000 men in aviation alone. The Corporation is pushing this program ahead aggressively pending the working out of final contractual arrangements.

With the urgent need for bombers, it was announced that the Corporation will begin immediately preparation for the manufacture of parts and sub-assemblies for twin-engined B25 medium bombers which will be finally produced by North American Aviation, Inc. In connection with this program, North American Aviation, Inc., has announced that it will begin immediately erection of a plant at Kansas City, Mo. It is expected that parts and assemblies will be in production in General Motors so that final assemblies can start by late summer.

The Buick Motor Division of General Motors will erect an airplane engine plant with a capacity of 500 engines a month. The engines will be the Pratt and Whitney radial.

The Allison Division, which is now producing at the rate of 350 engines a month, is expected to step up production to 1,000 a month by late fall. At that time it is expected that this division will be employing 15,000 men at Indianapolis, at the Cadillac plant in Detroit, and at Anderson, Ind., where an aluminum foundry has just been completed.

Manufacture of parts and sub-assemblies for the bombers will be handled by the Fisher Body Division of General Motors, with the work allotted to various Fisher Body plants and to other plants within the Corporation. Studies of the manufacture of airplane parts have been conducted by the Corporation for some time. In this connection, groups of supervisory employes and technicians have been sent to the North American Aviation plant in California for first-hand study of airplane manufacture, and satisfactory cooperative arrangements have been worked out.

Much of the work on bomber parts and sub-assemblies will be done in Cleveland and in the Detroit area, as well as in other plant cities where General Motors is now operating.

B. F. Goodrich Company

Scientific defeat of a mysterious "industrial bogeyman"—static electricity—which has caused a $3,000,000

Right on the Nose...

Effectiveness of air force operations, which depend on the accuracy with which planes can fly to their targets, calls for the ultimate in precision flight.

It therefore is only natural that long-range bombers, which must find their targets in all weather, are equipped with Kollsman Precision Aircraft Instruments.

By enabling pilots to reach both their targets and their bases "right on the nose," Kollsman is contributing vitally to the national defense program.

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annual loss in factory fires, menaced aviation safety and under certain conditions set off explosions in gasoline tanks, has been achieved with a new method of compounding both rubber and synthetic rubber so that static discharges pass harmlessly through, according to A. E. Juve, research expert of the B. F. Goodrich Company.

"Already being applied in gasoline hose, airplane de-icers and tires, surgical gloves, sheeting, tubing and anesthetic masks, heels, matting and flooring, and in home washing machines and other electrical machines, the new conductive compounds developed in the Goodrich laboratories have 'an electric resistivity possibly as low as one-millionth that of ordinary rubber' and are now enabling the oil and aviation, coating and other industries, as well as hospitals and filling stations, to thwart the danger of explosions and fires caused by uncontrolled static electricity. New methods evolved in the company laboratories for pigmenting and mixing conductive ingredients with rubber and synthetic rubber are used in these products," he said.

"Static charges may be developed in a number of ways. Primarily, friction between two insulating materials, or friction within an insulating liquid or gas, in itself, is required. Static charges may also be developed in the absence of friction, as when a liquid is broken up into small particles or a mist, or when a mist coalesces into larger particles," he explained.

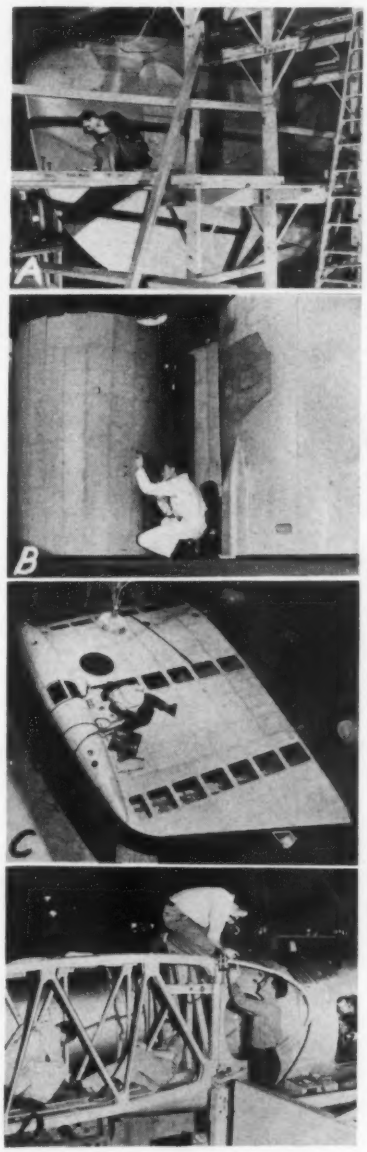
"Phenomena associated with the accumulation and discharge of static charges are experienced by every one. Aside from lightning, the most common experiences are probably the evidences of static charges in combing one's hair, scuffing of the feet on a dry carpet, separating two sheets of paper, and other similar occurrences," he said, declaring that these phenomena are usually not markedly objectionable.

However, "in industry, the discharge of a static accumulation in the presence of inflammable solvents or dust mixtures can be extremely hazardous."

"In factories, the uncontrolled discharge of static accumulations built up in belts, especially those operating on insulated pulleys, is largely blamed for an estimated annual fire loss of $3,000,000, according to the National Fire Protection Association.

"In aviation, the natural flow of air across the body of a plane in flight creates a charge which, if it were not controlled, would reduce the efficiency of de-icing equipment, while charges are built up similarly in airplane tires and also in automobiles.

"In the oil industry and filling operations, the new synthetic conductive is being applied to a gasoline hose nozzle which harmlessly discharges static, and allows charges accumulated to pass off without danger."



■ In order to clear floor space needed for National Defense orders, craftsmen at the Boeing plant in Seattle work under pressure to complete six new Clippers for Pan American Airways by early Summer. (A) The bow of one of the 42-ton flying boats, still encased in the scaffolding of the main hull jig. (B) Engine nacelles which will hold the four 1,600 hp. Wright Cyclone power plants. (C) A hydrostabilizer nearing completion. These also act as fuel tanks. (D) Riveters completing a wing stub work at close quarters with technicians installing a wing tank.

Boeing Aircraft Company

The first airplane of a fleet of six new Boeing 314-type Clippers ordered by Pan American Airways is rapidly nearing completion in Seattle and should take to the air on its maiden flight by the end of next month, considerably ahead of schedule.

Boeing workmen on January 14th moved the first completed Clipper hull out of its assembly building to the launching dock, where the main wing sections, the hydrostabilizers, engines and interior equipment are being installed.

News dispatches, meanwhile, have announced that Great Britain plans to purchase three of the new 42-ton Clippers from Pan American, for use in maintaining British Empire communications. Clippers 1, 2 and a later one are tentatively earmarked for the British, it was indicated.

Boeing expects to deliver the first Clipper soon after its launching and to complete delivery on all six ships by mid-year, instead of by early 1942 as originally planned in the contract. This accelerated production schedule will hasten to clear the Boeing plant completely for national defense production, as well as to make new equipment more quickly available for Pan American and British service.

The new Clippers are identical in size and design to the Boeing Model 314's now in service on the Atlantic and Pacific, but with a new engine-propeller combination, increased fuel capacity and other improvements.

Engines are Wright Cyclone 14's, with more horsepower available for take-off (1,600 instead of 1,500 hp. per engine) and with improved specific fuel consumption.

Propellers are Hamilton Standards, larger in diameter, and with an improved blade design based on recent N.A.C.A. laminar air foil studies.

Without changing the size of the hydrostabilizers, their built-in fuel tanks have been enlarged to hold an additional 1,200 gallons of gasoline, or a total fuel capacity of 5,400 gallons.

These changes mean improved performance, including quicker take-off, greater carrying capacity and an increase of cruising range to more than 4,000 miles.

The War Department announced today that the B-17D "Flying Fortress" is undergoing tests by the Army Air Corps.

The B-17D is an improved model of the B-17 series heavy bombers. This newest of "Flying Fortresses" is equipped with cowl flaps, armor plate and leak-proof fuel tanks. It is powered by four 1,200 hp. Wright engines, has a speed well in excess of 300 m.p.h. and a gross weight of 39.287 lbs.

It has a wing span of 103 ft. and is 67 ft. long. Provisions are made for a

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Rolling in swiftly mounting numbers! The U. S. Army's new Martin B-26's—world's "fightingest" bombers (*foreground*)**—rolling off America's most efficient equipment for production of bombardment aircraft. Next,** (*background*) **Martin 167 Attack Bombers for Britain's R. A. F. (remember Taranto?) and the great PBM Patrol Bombers—battle cruisers of the air, for the U. S. Navy. Defense is on the wing!**

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crew of from 7 to 9 men, including a commanding officer, pilot, co-pilot, navigator, bombardier, radio operator and gunners.

Lear Avia

Four new aircraft radio receivers with built-in interphone systems were announced this month by Lear Avia, Inc.

They are the 1940 versions of the two popular dry-cell powered models (AMR-1 and AMRL-1) and the two 12-volt battery powered models (AMR-12 and AMRL-12); the "L" models are arranged for operation from both the conventional antenna for aural reception and from the improved Learadio AMRL direction finding loop.

The receiver panel mounts vernier tuning control and dial, master on-off and volume switch, headset and interphone microphone jacks and antenna trimmer. The "L" models are also equipped with an additional trimmer for the loop, and the loop antenna selector switch.

The interphone feature is invaluable in student instruction, permitting radio intercommunication between the instructor and the student. No transmitter need be carried: the interphone system is a part of the receiver circuit.

The improved lightweight direction finding loop operates on the aural null principle and is available for operation in conjunction with the AMRL-1 and the AMRL-12 receivers. Measuring 10 in. in diameter, 13¼ in. high, and weighing 1 lb. 12 ozs. complete, the loop is mounted on a streamlined pedestal and is direct controlled, with a direct-reading 360° azimuth indicator.

Northeast Airlines

Northeast Airlines, Inc., serving northern New England, Montreal, and the Maritime Provinces, has undertaken, at the request of the Civil Aeronautics Administration, a training course for instructors in an advanced flight program, which is to be conducted throughout the country this coming summer.

This undertaking is the outgrowth of the desire of the air transport industry to cooperate in the National Defense Program. It was initiated at a meeting between Government and Air Transport authorities, at which time the Pilot Training Committee was formed by the Air Transport Association, with B. E. Cole, Chief of Flight Training, of Northeast Airlines as chairman. The curriculum now being taught has been developed during the past three months in collaboration with Mr. Grove Webster, Director of the Civilian Pilot Training Service and his assistants. It is believed that the training of pilots in precision cross-country flight, both with and without radio navigational aids, will be a very important contribution to national defense, and its initiation marks the first concerted attempt to train non-scheduled pilots in precision flight.

A sufficient number of instructors are to be trained to give a three months' course to 3,000 advanced students during the coming summer at some 80 schools throughout the United States.

The school will be running at full capacity by March 1st, at which time over 3,000 miles per day will be flown by students in addition to 4,000 flown daily on scheduled flight between Boston and Caribou, Boston and Moncton, and Boston and Montreal.

Piper Aircraft Corporation

With more than 100 Piper Cubs rolling off the assembly line every week, a real problem has arisen to ensure prompt delivery of the airplanes to their owners. Since nearly every experienced pilot throughout the country is busy in training work, distributors, many of whom take a dozen ships a week, are finding pilot material for delivery flights almost impossible to obtain.

To cope with this situation, Piper Aircraft Corporation has instituted a guarantee delivery service using its own employees. Since more than 300 Piper workers are qualified pilots, they welcome the opportunity to make cross-country flights. At a fixed rate of 9 cents a mile, cubs will be delivered to any point in the United States. This rate includes insurance for all coverage, all ship expenses and return rail or bus fare for the pilot. If a ship is damaged en route an entirely new one is delivered to the owner and the original ship, no matter how slightly damaged, is disposed of at the point of accident.

One of the main topics of discussion now at the Piper plant is deliveries. Thursday and Friday before week ends see the Delivery Manager's office crowded with eager employees looking for a trip to Kalamazoo, Denver, or Portland. Needless to say, the most popular deliveries right now are to Florida.

Radio Corporation of America

A new directional loop antenna for civilian planes which makes radio direction finding possible with a conventional aircraft receiver, has been announced by the Aviation Radio Section of the RCA Manufacturing Company, Inc.

This low-cost antenna makes possible accurate direction finding for the civilian pilot. It can be used to direct the plane toward a radio beacon or a radio broadcasting station or, by simple navigation, can be used to plot a course in any direction with the aid of radio bearings.

Although light in weight, the loop is designed to give long service under the most severe conditions. The antenna, measuring 12 in. in outside diameter, is provided in both local and remote control models. It will operate as a direction finder on the beacon (195-420 KC) band, or on the beacon and broadcast (195-420 and 495-1400 KC) bands. A high quality, air transport size unit, it combines high electrical efficiency with the rugged construction necessary for passing Civil Aeronautic Authority requirements.

A custom-built radio receiver capable of receiving broadcasts on the weather band of the Civil Aeronautics Authority, as well as radio range signals for navigation purposes, is being built into the 1941 Piper Coupe as standard equipment.

Designed and built by the aviation radio engineers of the RCA Manufacturing Company, the new receiver has been found in flight tests to have a range of 250 miles in reasonable weather conditions. The outstanding feature of this installation, resulting from the cooperative installation by Piper and RCA engineers, is its high performance without the use of ignition system shielding of any kind. The unit is completely self-contained and is operated by a vibrator powered from the plane's battery.

United Air Lines

Looking forward to the use of new static-free ultra-high frequency radio "highways" of the air, United Air Lines has begun the installation of 100 special radio receivers on its entire fleet of Mainliners at a cost close to $100,000.

According to J. R. Cunningham, director of communications for United, first use of the receivers will be made in connection with u.h.f. radio range stations being established by the Civil Aeronautics Administration between Chicago and New York. This work has been described as the start of installations to be made all along the nation's airways.

The u.h.f. radio range is declared to be superior to the low frequency type now in use because of its fidelity of transmission and freedom from static. Frequencies to be used on the New York-Chicago airway range from 119,000 to 126,000 kilocycles as contrasted with the present 200 to 400-kilocycle band.

The new radio range stations will be located at North Beach, New York; Easton, Sunbury and Moshannon, Pennsylvania; Milbrook, Cleveland and Toledo, Ohio; Goshen, Indiana, and Chicago.

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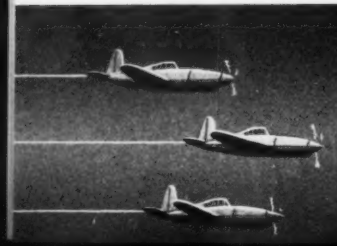
Stinson Aircraft, a division of Vultee is now in production on a new commercial plane for 1941. Write Stinson for complete information.

Above illustration—Largest single delivery of airplanes to U. S. Army Air Corps. 31 Vultee BT-13 planes in mass formation over Vultee Field, California.



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Ninth Annual Meeting of the Institute of the Aeronautical Sciences

ALEXANDER KLEMIN*

Introduction

As in previous years, Dr. Klemin has again made available to the Institute a summary of the proceedings of the Ninth Annual Meeting of the Institute, held at Columbia University in New York, January 29–31, 1941. It was not possible, for a number of reasons, to review all the papers presented, although the present report does indeed deal with the majority of the papers. The omission of a paper by no means implies that it lacked importance. All comments and opinions given regarding the papers presented are the personal opinions of Dr. Klemin. Preprints of these papers are not available and requests for such preprints should be addressed directly to the authors. Many of the papers presented at the Ninth Annual Meeting will be published in full in forthcoming issues of the regular edition of the Journal of the Aeronautical Sciences.

THE scope of the meeting was comprehensive. Sessions were devoted to Aerodynamics, Structures, Organic and Synthetic Materials, Power Plants, Airplane Design, Rotating Wing Aircraft, Air Transport, Radio and Instruments, Physiological Problems, and Meteorology, and are reported here in this order. As usual, there was a noted and representative gathering in attendance from industry, governmental air services and the universities. A total of 700 persons attended the meetings.

Aerodynamics

No discussion of applied aerodynamics is complete without mention of stability and control, and two papers were devoted to this inexhaustible topic. The criteria of stability and control have not been established satisfactorily after all the years and George S. Trimble, Jr., of The Glenn L. Martin Company, in a serious analytical paper entitled *"Factors Affecting Elevator Control Force,"* began by saying that while the elevator forces required to control an airplane have become of prime importance, the attempt to establish a criterion for them has not been very successful. Longitudinal stability and control forces are inseparable. The more statically stable the airplane, the greater the control forces become. Free Control Static Stability depends not only on fixed control stability, but also on Control Surface characteristics. As the altitude of the airplane changes, so does the angle of attack of the horizontal tail, and, in most cases the hinge moment of the elevator. The character of such a hinge moment variation with angle of attack determines the control free elevator position relative to the fixed surface. The slope of the pitching moment curve of an airplane with fixed controls has been widely used as a criterion of static stability. The weakness of such a criterion is that it has no reference to the stick forces and to the stability with free control. With considerable mathematical analysis to support his views, Trimble suggests a new criterion, namely, the rate of change of elevator stick force with speeds, first because its value is affected by all the variables associated with longitudinal control, and second, because it is easily measured on the airplane in flight. Further, since his analysis showed a definite relationship between the stick force criterion and the longitudinal stability with controls free or fixed, he thinks that the same criterion could be used as a longitudinal static stability criterion. There is a good deal to be said in favor of these arguments.

George S. Schairer of the Boeing Aircraft Company presented a paper dealing with stability under the title *"Directional Stability and Vertical Surface Stalling."* Wind tunnel tests and comparatively minor changes in the vertical tail surfaces made an enormous difference in the directional stability of the Boeing Stratoliner in its early wind tunnel form. For the detailed aerodynamic studies readers must await publication of the paper. What was found particularly novel and most interesting were notations of the maneuvers of the multi-engined airplane in the case of "sudden and unsymmetrical engine failure." Also of interest is what the author considers a test for adequate directional stability of a four-engined airplane. "Adequate directional stability has been demonstrated repeatedly by simulating an engine failure during a landing approach with flaps full down at speeds below 85 m.p.h. While in this condition, the throttles on all engines except the left outboard engine are opened, the airplane is placed in a climb, and the landing approach abandoned. This is probably the supreme test for any airplane. A four-engined airplane would be little safer than a two-engined airplane if it did not have the directional stability and control characteristics necessary to make such a maneuver."

That two papers on Stability and Control should be accompanied by two papers on Flutter was not surprising in view of the increasing importance of flutter in high-speed airplane design. A progress report, *"Some Experiments on Wing Flutter"* by William Bollay and Charles D. Brown of Harvard University brought to light some interesting phenomena. A wing, free to vibrate in bending and in torsion, was subjected to forced vibration at various air speeds up to the flutter speed. These measurements showed that the two natural frequencies of the wing come together as the flutter velocity is approached. The second part of the investigation dealt with the problem of flutter above the stall. Measurements showed that at angles of attack above the positive stalling angle and below the negative stalling angle the flutter speed is decreased to less than one-third of the flutter speed of the unstalled wing. This flutter appears to be associated with the negative slope of the left and an excitation arising from a row of Kármán vortices.

Charles B. Lyman's (Bureau of Aeronautics, Navy Department) paper on *"Airplane Vibration Tests and Their Role in the Solution of the Flutter Problem"* (presented in the Airplane Design session) cannot be summarized because it is in itself a summary of the state of the art and of the experimental technique, constituting an admirable introduction to the whole theory and experimental technique of flutter—in readable, non-mathematical form.

Structures

The structural design criteria for moving control surfaces are: (a) strength, (b) dynamic balance requirements, (c) rigidity and (d) weight and cost. These requirements and how they might well be met by the use of stainless steel were studied by C. G. Cudhea of Fleetwings, Inc., on the basis of both analysis and tests and presented in his paper on *"Stainless Steel Control Surfaces."* As far as strength goes it is probable that the majority of modern control surfaces have high margins of safety. The author was of the opinion that to reduce the coefficient of dynamic balance almost to zero at high speeds is irrational, and that the rules are far too severe. The requirements of dynamic balance should be tempered by consideration of the structural rigidity. The installation of masses having no structural function, but merely serving the purpose of balancing the control surface, is not considered good practice. It is more desirable to have the leading portion of the movable control surfaces sufficiently

*Chairman, Daniel Guggenheim School of Aeronautics, New York University.

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rigid so that with light structure and fabric covering the trailing portions, a sufficient approach to static and dynamic balance will result. The use of airplane fabric for movable control surfaces should be permitted at far higher speeds than today. The location of the hinge line is one of the most important factors affecting the weight of surfaces requiring a low degree of dynamic balance. Every effort should be made to use hinge locations of at least 20 per cent or more. Control surfaces in stainless steel with a rigid, relatively heavy structure forward, and light ribs and fabric covering rearward, should in skilled hands give a most satisfactory solution meeting all the above requirements.

N. J. Hoff of the Polytechnic Institute of Brooklyn discussed the "*Proportioning of Aircraft Frameworks.*" The proportioning of the bars of frameworks involves two different tasks. It must be shown that the maximum stresses caused by all external loads are less than the allowable stresses for the material used, and that the axial forces in the bars are smaller than their first critical or buckling values. These two problems are to some extent independent. The method suggested tackles both tasks simultaneously and also eliminates two inconsistencies often encountered in aircraft design. One of these is the untenable assumption of a constant restraint coefficient for all bars. The other is the untenable neglect of the bending stresses caused by transverse loads such as seats, control devices, etc.—applied to the bars between the joints. The fact that actual fuselages do not fail or seldom fail in spite of these inaccuracies is due to overestimation of the loads, or underestimation of the effects of rigid joints or the general tendency to increase areas of parts "just because." The author is quite right in saying that to save weight the analysis should be as refined as possible. The following statement of the method he proposes is unfortunately too brief, but may serve as an introduction. Three distinct steps are involved. In the first step the sizes and gages of the bars are chosen upon arbitrarily assumed values of the coefficients of end restraint. In the second, this choice is refined by checking the assumed values by approximate but rational methods, and by changing the sizes and gages to obtain sensibly uniform strength in the structure. In the third step a final check of the moment distribution and of the stability is obtained by the use of the Hardy Cross Method. While the new method is more laborious than the method of checking only buckling loads of each bar individually under the assumption of a coefficient of restraint of 2, it is thoroughly worthwhile.

Eric Reissner of the Massachusetts Institute of Technology approached the problem of shear lag from a novel point of view, in a contribution entitled "*Least Work Solutions of Shear Lag Problems.*" The problem of the distribution of stresses in the cover sheets of box-beams acted upon by bending loads is treated by assuming parabolic bending stress distribution across the sheets and by determining the spanwise variation of the vertex curvature of the stress parabolas (which in the ordinary beam theory are straight lines). The equation has constant coefficients if there is no taper in sheet width and thickness, variable coefficients for tapered sheets. The equation is found to be integrable in terms of elementary functions for untapered beams, and for a rather general class of tapered beams. The development of the method should permit a relatively simple solution for most practical problems in this field of stress analysis.

Materials

There has been immense interest in and much publicity given to the so-called "plastic" airplane. In reality no plastic airplanes have been or are being built, but owing to the improved characteristics of modern plywood and improved methods of handling it, there has been simply a revival of aircraft plywood construction, once so popular. Thomas D. Perry of the Resinous Products & Chemicals Co. in his paper on "*Aircraft Plywood and Adhesives*" debunks the plastic airplane, and sets forth very fairly the properties and possibilities of modern plywood in regard to airplane construction.

The use of plywood in the first world war was quite general in spite of disadvantages. It was not its inflammability, however, which acted as a limitation. The author correctly

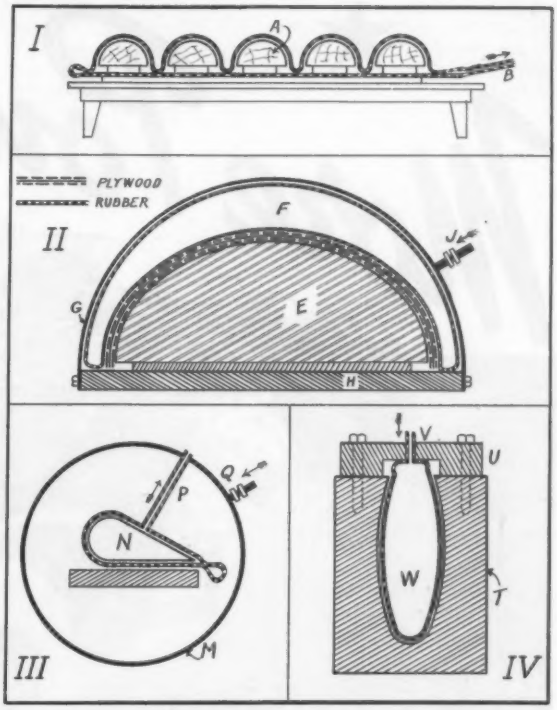

FIG. 1. Molding Processes.

stated that the major fire hazard is in the fuel, and that from a fire point of view it matters little whether the material is fabric, plywood, wood or metal. The real limitation was in the character of the adhesives, mainly casein and albumin glues. Such adhesives would not stand mold and fungi tests, and both encouraged parasitic growths with casein. Resistance to soaking and boiling water was unsatisfactory. Since 1930 and the rapid growth of the plastic industry, resin adhesives have come into use. Today resin adhesives of the phenol formaldehyde and urea formaldehyde group are available, and the following advantages have been secured: (1) complete water-proofness, adhesive insoluble until wood decays, (2) high resistance to bacterial growth, and (3) boilproofness, facilitating bending and curving after steaming. Liquid phenolics are found to possess the same desirability as the resin in film form. The technique of bonding with film is particularly simple but whether phenolic film or liquid is employed the assembled sheets of veneer and adhesives are subjected to simultaneous heat (300°F.) and pressure (125 to 250 lbs. per sq.in.). Urea groups can be set at the low temperature of 70°F. Another important development is that of high density plywood, sometimes called superpressed plywood, by impregnation and compression processes. The author writes, "This favorable change in plywood strength characteristics through increase of density is somewhat analogous to the alloying and heat treatment of metals to improve their qualities. It gives to wood workers an opportunity to meet design requirements that are far beyond the range of normal wood or normal plywood."

As previously stated, plastic airplanes is an inaccurate description as the airplanes so far have been merely made of molded plywood with resin adhesives and finish. "The principles involved in molding plywood are old, and the only novel features were the methods of applying the pressure as well as the unusually large size of the molded unit. The fundamental principle involved is that of using an inflated or deflated rubber bag as one of the halves of a pair of molding dies. There is not only the saving in matching up a pair of dies where the intermediate distance between halves must be very accurately determined, but in many cases the dies are wholly eliminated and, in any event, rubber bag pressure

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is of the order of fluid pressure and at substantially right angles to any surface that is under pressure. The Duramold, Turin and Vidal processes all utilize this rubber bag pressure principle. Several of the more important applications are illustrated in Fig. 1 taken from Perry's paper. There is not the slightest doubt that plywood now presents many new and undeveloped possibilities in the aircraft industry.

Rubber is another material which has come to play an increasingly important part in aviation, yet engineers do not understand rubber as well as they do steel, so that two closely related papers, one dealing with its properties and the other with its applications, were received with welcome.

In the first of these two papers, J. W. Schade of the B. F. Goodrich Company, in his paper on *"Natural and Synthetic Rubbers,"* pointed out that the word rubber is now used to designate a class of flexible, elastic materials rather than a particular hydrocarbon product of natural origin. The synthetics are now classified into five types—(1) Neoprenes, (2) Thiokols, (3) Perbunan Bunas, Ameripols, Hycars, Chemigun, (4) Koroseal, and (5) Vistanex.

All rubbers consist of molecules with 200 to 4400 C_5—H_8 units per molecule depending on preliminary treatment of the hydrocarbon. How long chains of carbon units are built up by plants is not known, but such chains can be artificially produced by chemical polymerization which may be likened to the formation of a metal chain, the individual links representing the simple molecules, the completed chain the poligner. Links may be all alike or different materials may be joined in the same chain. The mechanical properties of all types are determined not by the kind of chemical elements comprising them but rather by the arrangement of these elements, the size of the molecules and by structures produced by vulcanization. Vulcanization usually involves breaking of one atomic bond and direct or indirect chemical union with a similar bond of another chain. Rubber compositions are of great variety and can be widely modified by addition of other materials to fit them for a variety of uses. The field is new and rapidly expanding. From the point of view of the engineer or constructor it is important to bear in mind this complexity and variety and to exercise great care in the selection of a rubber for a specific purpose. The question of whether natural or synthetic materials should be used can be answered as follows. Synthetics have superiority in resistance to (1) swelling or deterioration in contact with oils, organic solvents and water, (2) cracking in sunlight, (3) deterioration by heat, (4) powerful oxidizing agents, and (5) diffusion of gases. Natural rubber still exhibits superiority in (1) elasticity and rebound, (2) low heat generation through hysteresis, (3) extensibility, and (4) resistance to stiffening at low temperatures.

This is the picture today. No one can predict how it will be changed in the next few years.

Charles J. Cleary of the Materiel Division, Wright Field, discussed the very timely topic of *"Specific Applications in the Army Air Corps of Vulcanized and Rubber-Like Materials in Airplane Construction."* Striking advances in airplane construction have been preceded in many instances by advances in rubber. New synthetic materials with improved physical and chemical properties have greatly enlarged the aircraft uses of rubber. Rubber is a strategic material and the development of substitutes is a matter of military importance. Specific applications of rubber to aircraft which are of major importance today are (a) tires and tubes, (b) hose, (c) engine mounts and shock absorbers, (d) de-icers, and (e) gaskets, packings, etc. The author first discussed tire shape, materials and performance, a description of the differences between aircraft and automotive equipment, and the suitability of synthetics in the construction of aircraft tires, supporting his discussion with a wealth of data. Aircraft hoses were discussed under the grouping of (a) fuel, oil and coolant hoses, (b) hoses for hydraulic systems and (c) flexibly mounted instrument boards. All of these hoses use the chloroprene polymer or the Butadiene Polymer types of rubber-like material for the inner tube and outer cover because of their superior performance with and insolubility to mineral oils and organic fluids for which they are conductors. Flexible engine mounts are reduced to the basis of "Spring-rate." The material giving best spring-rate or springiness is natural rubber. Other considerations such as fatigue action of oil, etc., are of secondary importance in using rubber in engine mounts. In de-icer equipment performance is the sole criterion. Attachment of the shoe must not disturb aerodynamic form, body and inflating tubes must have good elongation characteristics, outer surface must resist sun, weather and oil, and a coating of cement should prevent accumulations of static electricity. The author also discussed packings, sponge rubber for camera mounts and sound and heat insulation; and other materials.

The two papers combined will give the aircraft man a great deal of information but may still leave him with the view that a rubber technologist should pick the material for a given application.

Aircraft Engines

The session on aircraft engines dealt exclusively with light engines.

Harold E. Morehouse of the Lycoming Div., Aviation Manufacturing Corp., reviewed *"Light Aircraft Engine Developments"* beginning with their early history. He emphasized the supremacy of the opposed type and gave reasons for such popularity. Under the subtitle, *"Present Trends of Design,"* the author defined practice which is now general in the light engine. Powers in the opposed cylinder engine have increased from 40 to 80 hp.; a six cylinder engine of 125 hp. may now be expected. Perhaps the most original part of this paper dealt with the future of the light airplane engine. In relation to this type: (1) muffling, (2) better mounting, (3) use of six cylinders, (4) battery ignition because of electric starters and generators, (5) oil filters and carburetor air cleaner, (6) propeller reduction gearing, (7) a controllable pitch propeller, and (8) a simple supercharger may be expected.

Carl T. Doman of Air Cooled Motors Corporation enumerated the *"Development Problems of Light Aircraft Engines"* in an effective fashion, covering almost every phase of design. He pointed out that cooling of the small in-line engine was not understood too well. In many cases he had found that on the test stand an engine might average 400° cylinder head temperature with 100° air temperature at continuous full throttle power at rated speed. In the airplane the same engine might have cylinder temperatures of 550° and only by the most tricky baffling could the temperatures be taken back to anywhere near a safe temperature. The author believed that the makers of light plane engines might be forced to use blowers for cooling, so that the airplane designer could submerge the engine in the fuselage or wing. Cooling could be attained with a power expenditure of approximately 4 per cent provided there was sufficient space to use a blower of efficient proportions. A blower of the backward curve type with an efficiency of 50 per cent would weigh only 3 lbs. for a 100 hp. engine.

A. R. Rogowski of the Massachusetts Institute of Technology, in his paper on *"Possibilities of the Two-stroke Cycle for Small Aircraft Engines"* was of the opinion that a piston-ported loop-scavenged two-stroke engine is well adapted to provide light plane industry with a simple light and reliable low-cost engine provided the fuel consumption at high outputs could be reduced by means of relatively inexpensive fuel-injection equipment. He described experiments with a single cylinder experimental engine of 4 in. bore and 6 in. stroke illustrated in Figs. 2 and 3. The cylinder is enclosed in an outer barrel and split longitudinally. One section contains the inlet ports and the other the exhaust ports. The crank angle at which the piston uncovers the ports may be varied by sliding one or the other section up or down within the barrel so that port timing can be varied. The inlet ports are radial about a point on the inlet side of the cylinder to cause the scavenging air to rise vertically on the inlet side of the cylinder without the use of a deflector piston. A scavenging blower is provided. A wide range of experimentations whose character the reader can readily imagine leads to the following interesting conclusions:

(1) The simple piston-ported loop-scavenged two-stroke engine will have a higher specific output than the corresponding unsupercharged four-stroke engine.

(2) Using a carburetor without charge stratification, the

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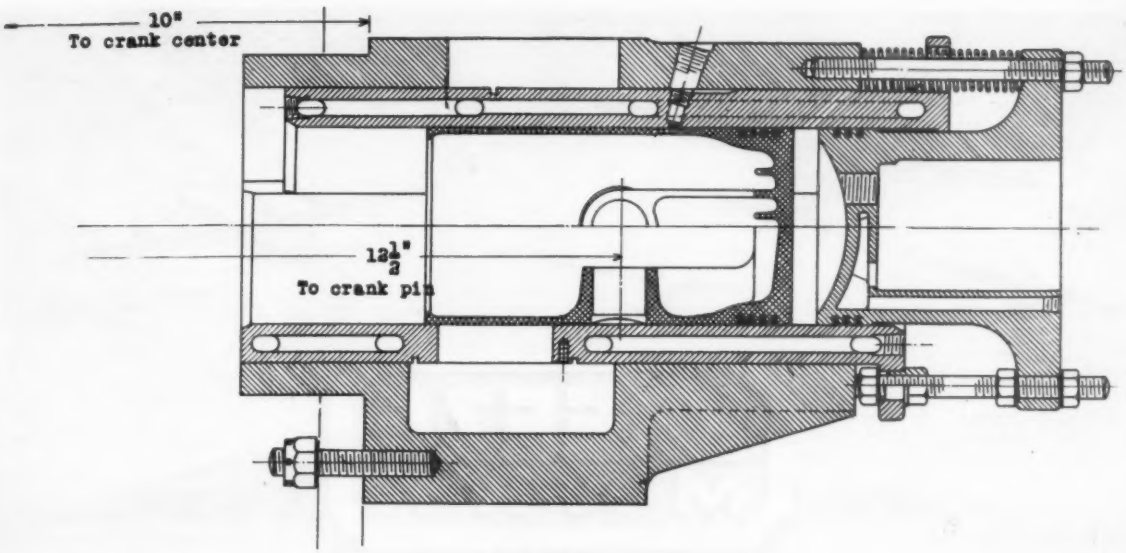

FIG. 2.

specific fuel consumption of this type of engine will be too high for most purposes, at mean effective pressures above 50 lbs. per sq.in.

(3) The specific fuel consumption obtainable with injected fuel will be entirely satisfactory.

(4) Because of its mechanical simplicity, this type of engine should be much easier to produce in quantity and should be more reliable in service, resulting in lower first cost and upkeep.

(5) Cost and upkeep may be somewhat adversely affected by the necessity for blower and fuel injection equipment, particularly the latter.

FIG. 3.

The author's experiments substantiate the views which have been held for many years by authorities regarding the possibilities of the two-cycle gasoline engine with fuel injection.

Airplane Design

The Airplane Design session took in a wide range of subjects, air-cooled *versus* liquid-cooled aircraft; flying boat design; flutter, etc. Quite rightly the sponsors of this session placed on their program broad problems of high importance in preference to detailed aspects of design. The first and most important topic discussed was "*Air-Cooled versus Liquid-Cooled Aircraft*" by John G. Lee of United Aircraft Corporation. The author made a thorough comparative study of airplane designs around air-cooled and liquid-cooled engines to the same specification, and in his analysis covered aerodynamics, cooling, fuel consumption, weights, etc. The analysis, made with objectivity and care, cannot be detailed here; the conclusions will be received with interest everywhere if not with complete agreement. They were definitely in favor of air-cooling. To quote some of the author's views:

"A very good qualitative case can be made for the superiority of the air-cooled engine as regards serviceability and vulnerability. A bullet through the cooling fins or the baffles, for instance, will not stop an engine.

"In this study it has been clearly brought out that, on the basis of equal weight, equal cleanness, and equal maneuvering characteristics, the air-cooled installation can equal the speed of the liquid-cooled and surpass it in take-off, climb, and ceiling. When range and weight-carrying ability are the primary consideration, the air-cooled has every advantage."

Why then, asks the author, are not all the engines of the warring nations of the air-cooled type? The answer is not technical; it is practical.

"The Germans have specialized in liquid-cooled engines ever since the last war. What few air-cooled types they have built have been of American design, built under license. Judging by the fact that the Germans continued to buy American radials for some years, it may be inferred that they never really mastered the air-cooled types. The English have built both types, as did the French. However, the application of Meredith's ducted radiators to the liquid-cooled pursuit planes in advance of the time when his principles were applied to the air-cooled pursuit, gave the liquid-cooled type a temporary speed advantage. This advantage came at the time England was going into war production, so it was natural that her pursuit airplanes would be built around liquid-cooled installations, while her bombers used the air-cooled."

It is sincerely to be hoped that the author is correct, since there will be a tremendous factor in favor of the British with American equipment at their disposal.

Since jet propulsion always draws a smile from engineers, it took some courage on the part of H. B. Dickinson of the

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Lockheed Aircraft Corporation to read his paper on *"Propeller Design Problems of High Speed Airplanes."* The author's extensive calculations indicate that on the basis of existing high speed airfoil data, propeller efficiencies in excess of 40 per cent do not appear possible at speeds above 500 m.p.h. at 20,000 ft. (Of course this implies that present propeller blade thicknesses cannot be reduced.) The design of high speed propellers is dictated wholly by compressibility considerations. The blade width, thickness, pitch distribution, airfoil sections, etc., must all be adjusted if reasonable efficiencies are to be maintained at the airplane speeds now being approached. Research is now urgently needed on (1) airfoils at subsonic and supersonic speeds, (2) propellers at high forward speeds in wind tunnels, and (3) propellers in free flight at high speeds. Moreover, the breakdown of propeller efficiency indicated by airfoil data should serve as an incentive for accelerated research on jet propulsion. This device might well extend the attainable speed of current airplanes to the neighborhood of 550 m.p.h. at 20,000 feet.

Rotary Aircraft

The meeting indicated that the interest in rotating wing aircraft is keener than ever—as it should be when it is considered that the past year has seen the successful flight tests of the Sikorsky Helicopter and the new Pitcairn Autogiro, both of which have been remarkably successful. Other developments in rotating wing aircraft which still retain a confidential character have been equally encouraging. The sessions were well attended and elicited discussion.

Captain H. F. Gregory of the U.S. Army Air Corps, Wright Field, in a paper on *"Recent Air Corps Developments in Rotating Wing Aircraft,"* indicated how steadily Wright Field has encouraged autogiro progress. With a two-pitch position rotor an accelerated take-off mechanism has been attained which allows take-off at a minimum speed of 20 m.p.h., that is, after a very short turn. Direct take-off is to be provided by inclusion of a third pitch position, the position of maximum lift. The return from maximum lift position to the normal pitch setting is achieved automatically by the action of centrifugal force on a weight restrained by a spring and interconnected to the blades by a control linkage. To accompany the direct take-off rotor, improvements have been made in the starter mechanism. A new autogiro, to be redesignated the XR-3, will embody feathering control. Mounting of the pylon in rubber has reduced vibrations to a marked extent. A new landing gear with a travel of 26 inches will permit landing from a vertical descent. A rotor with blades having stable center of pressure, tapered in plan and thickness, has proved much more stable than earlier rotor designs.

Victor R. Haugen, also of the U.S. Army Air Corps, Wright Field, described *"A Whirl Test of an Autogiro Blade"* at the propeller laboratory of Wright Field. A test at 298 r.p.m. caused blade failure because the vent hole in the tip of the blade was not sufficiently large to exhaust the pressure created by the centrifugal action on the column of air extending through the interior of the blade. A larger vent hole and reinforcing of the fabric attachment allowed the blades to be turned up to 440 r.p.m. (a very high figure for an autogiro rotor).

Lloyd H. Leonard of the Bureau of Aeronautics, Navy Department, presented some radical conceptions in his paper entitled *"Possibilities of a High Speed Helicopter."* Because of compressibility effects and the generally low efficiency of the rotor in forward flight it is difficult to imagine a helicopter flying at, for example, 500 m.p.h. The author imagines an aircraft which shall have the take-off and landing characteristics of a fast airplane. This is how he describes the proposed aircraft: "It is intended that the machine take-off and climb along a vertical or steeply inclined path, utilizing the upward thrust of moderately large diameter rotors. Upon reaching a suitable altitude, the entire machine is turned through an angle of about 90° to the horizontal flight attitude, whereupon it may be dived, if necessary, to gain flying speed. During horizontal flight the rotors act as large diameter counter-rotating tandem propellers and the machine functions essentially as an airplane" (with, of course, very small wings designed only to sustain weight at very high flight speeds, with a loading of 200 lbs. per sq.ft.).

The author, by imaginative sketches and aerodynamic analysis, makes out a plausible case. But the idea is not novel and closer study is apt to reveal very great difficulties in this type of combination aircraft, helicopter plus airplane.

In another paper on *"The Propulsion of Helicopter Rotors"* Edward A. Stalker of the University of Michigan propounded another radical suggestion. The one serious difficulty in the helicopter is in the counter-action of the large torque of a slow power-driven lifting rotor. There have been offered many solutions, such as rotors rotating in opposite directions, auxiliary propellers to resist torque, propellers mounted on the rotor blades, nozzles emitting jets from the blades. None of these satisfy the author completely. High velocity jets of restricted area give low efficiency in applying power to blade rotation. Therefore, he suggests the following: "Air is delivered into the rotor and from there into the individual blades. It escapes from rearward directed slots in the blade surface. The ejection of this jet reduces the form drag of the blades very appreciably. This is a very significant feature in making for efficiency of propulsion. Also, by using a large mass of air, made possible by the large jet cross-sectional area, little energy is left in the jet aft of the trailing edge of the blade, so that the net efficiency is high." The paper is interesting and scholarly plausible, but not entirely convincing.

As stated previously the development of the new Pitcairn autogiro PA-36 has been one of the outstanding events of the year. Adequate descriptions have already appeared in the technical press which emphasize many developments such as centralization of flapping hinges, variation of pitch for jump-off, etc. A. E. Larsen of the Pitcairn Autogiro Corporation in his paper on *"Development of the Latest Type Pitcairn Autogiro,"* clarified and strengthened the accounts appearing in the trade press.

I. I. Sikorsky of Vought-Sikorsky Aircraft, United Aircraft Corp., in his account of the *"Development of the VS-300 Helicopter,"* strengthened and clarified previous trade paper accounts of his remarkable craft which has achieved all-weather helicopter flying characteristics with the simplest means. The famous airplane designer has returned to his first love, the helicopter.

Air Transport

American air transport is growing both rapidly and steadily. Its further growth is endangered by the possible dearth of new equipment when military priorities are enforced, and by the call to military or naval service of many of its skilled men. Hence the timeliness of the address by T. B. Wilson of Transcontinental & Western Air on *"The Place of the Air Transport Industry in the National Defense."* This great new industry is ready to serve in any capacity that national policy may demand. But, said the author, "The question of converting the present commercial airliners to military use as combat planes may be regarded, therefore, as highly impractical, and of little importance in solving the problem of military aircraft production." Another question was, "Should the government transfer pilots on commercial airlines to military service?" The speaker did not think so. Commercial pilots are trained to caution and safety, not to combat. Here is the crux of the matter. "Even if commercial airlines were broken up or forced into temporary retirement at this critical stage when our national existence may depend upon our ability to achieve and maintain supremacy in the air, it is probable that we should have to rebuild an air transport system to fulfill the need for a supply service as an auxiliary arm of our combat operations, which would be a wasteful and costly procedure."

Until recently it has been taken for granted that only where great distances are involved could an air transport service be justified. C. Bedell Monro of Pennsylvania-Central Airlines Corporation, in discussing *"Short-Haul Air Transportation"* set forth a contrary view quite convincingly. After examination of recent experience with short-haul lines, and close study of the entire problem, he came to the following conclusion: "There is certainly a vast reservoir of untapped business, in the cities now enjoying air service and in communities which in size and commercial activities justify being added to the airline map. There is unquestionably a point beyond which extension of services would not be justi-

Armored Aircraft

Many of the armored bugs such as the Hercules Beetle shown here have solved a problem that at present is engaging the attentions of some of the world's leading aviation engineers. That is the protection of the vital parts of aircraft with armor plate without sacrificing too much flying ability.

There are two approaches to the problem. One is essentially in the province of the metallurgist—the development of lighter, stronger armor steels. The other falls to the aviation engineer—the designing of planes to carry successfully the extra weight armor necessarily imposes. Since more weight automatically calls for more *power*, Ethyl engineers, by working closely with aviation engineers in a program of practical research, are privileged to contribute toward our national defense.

Every pound, every ounce shaved from the weight of future engines can be put into life-saving armor. At the same time, the data gained from this cooperative research are largely fundamental in nature. While certain immediate applications may be of military nature, the greatest ultimate value will be to commercial aviation. The information that is being developed will be of inestimable value to the aviation technologists who seek to safeguard American air supremacy—whether military or commercial.

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fied—where schedules would be patronized more by civic pride than by actual travel. But even for that category it seems inevitable that at some future time a network of feeder lines, operated with small airplanes at a low cost, will supplement the main line services."

Without regulation air transport would be very hazardous. Too much regulation would stifle its growth. Robert J. Smith of Braniff Airways, in a scholarly and philosophical study of *"Economic and Technical Aspects of Air Carrier Regulations,"* seems to have established the principles of such regulation splendidly. Regulation should not be designed to provide absolute safety, but to provide for progressively safer operation of aircraft. The date for the introduction of new safety regulations is important; too early introduction may stifle economic progress. When improved equipment is available, it should be purchased; penurious allowance in rates of depreciation would be contrary to public interest and might impair the capital of the industry. All regulatory bodies might well study this paper.

In recent months air freight has received much publicity as the coming development in airline transportation. The carrying of air cargo can only be successful if the Air Express charges are reduced to a fraction of their present values. How can charges be reduced? By the design of a special cargo plane whose characteristics were presented by Adolph Burstein of the Stinson Aircraft Division of Vultee Aircraft, Inc., in a paper entitled *"The Effect of Design Variables on Cargo Plane Performance."* There is not much difference between the airliner and the cargo plane. Lower cruising speed, lower weight per square foot, higher weight per horsepower and operation at a greater per cent of full power seem to lead to a more commercial type of airplane. This is a first attempt at the problem, which will ultimately be solved not by design alone, but by trial and error over a period of many years.

Radio and Instruments

Walter Wrigley of the Sperry Gyroscope Company gave a useful warning to pilots and airplane operators interested in avoiding compass errors in his paper on *"Effect of Compass Location in Aircraft on Dynamic Errors."* A compass may be located either for convenience or from necessity at some distance from the center of gravity of large modern aircraft. Such a location may give rise to dynamic errors in the readings of the compass due to accelerations of roll, pitch, and yaw—the acceleration of yaw is probably the most serious. Magnitude of the dynamic errors increases linearly with the distance from the center of gravity—errors may exist as magnitude effects up to several degrees, or as phase effects up to almost 180°.

Robert W. Knight of the Civil Aeronautics Administration described the *"Flight Level Indicator,"* an instrument to avoid collisions. As traffic density grows it becomes increasingly important that pilots keep to predetermined levels. An authority estimates that there will be 100,000 pilots in the United States by the end of 1941, and that by 1945 volume of air traffic will be 20 to 30 times what it is today. If all aircraft were equipped with adjustable altimeters and adequate radio equipment energetically used, there would be little density of collision. As matters stand a more positive method of altitude separation is necessary, and hence the Flight Level Indicator, in which uniform pressure altitude measurement from an absolute base (29.921 in. Hg) by a non-adjustable instrument is provided for the pilot. The instrument, like an altimeter, is not an indicator of altitude but is an absolute pressure gage calibrated to the "standard" atmosphere. The face of the Indicator is similar to that of a magnetic compass, marked off N, E, S and W and subdivided in intervals of 10° or less. A pointer attached to the aneroid mechanism indicates the "flight level" at which the airplane is flying in terms of the compass heading. The pointer makes a complete revolution (360°) for every change of 2,000 feet in nominal altitude. There is a direction marker on the outer edge of the dial which, for convenience, can be set manually to the desired compass heading. A subdial, which is visible through an aperture below the center of the main dial, indicates flight levels by numbers. Flight levels are units of nominal altitude of 500 feet each; thus level 4 indicates, against a reference index on the fixed dial, the number of the level, or the nearest level, on which the airplane is being flown. There are 32 flight levels representing 16,000 ft. of nominal altitude.

Flight levels are automatically related to the appropriate magnetic compass bearings in accordance with the formula:

$$L = [(C + 90)/90] + 4n$$

where L is the number of the flight level, C is the magnetic compass bearing in degrees and n is the number of revolutions made by the pointer.

Here is an example of practical application. Suppose a pilot wishes to fly at an altitude of approximately 6,000 ft. on the airway from New York to Philadelphia, with a magnetic compass bearing of 233° (*i.e.*, in a southwesterly direction) without correction for drift.

(1) Before taking off the pilot would set the index marker to 233° for ready reference.

(2) After taking off he would climb until the subdial reading indicated that he had passed level 11 (nominally 5,500 ft. since each level is 500 feet). This would get him roughly into the desired altitude. The pointer would have made 2 complete revolutions.

(3) He would then continue flying until the rotating pointer indicated 233° coinciding with the direction marker. At this stage the number of revolutions made by the pointer would have been 2 and from the formula:

$$L = [(233 + 90)/90] + 8 = 11.6 \text{ approximately}$$

giving the pilot roughly the desired altitude.

(4) He would then level off and maintain this reading. The procedure is thus quite simple.

There would still be the remote possibility of collision caused by an overtaking aircraft flying exactly the same track and level as the one ahead, but otherwise a great measure of safety is provided.

David G. C. Luck of the RCA Manufacturing Company described *"The Omnidirectional Radio Range."* From a purely theoretical standpoint the indications given to the pilot by the omnidirectional radio range would solve nearly all of the navigational and traffic control problems confronting aircraft operators in the United States. This paper dealt with the various navigational and traffic control problems and showed in a straightforward manner how this new radio range could be applied to permit increased traffic converging upon busy terminals at the same time decreasing congestion upon already crowded airways. The omnidirectional radio range consists of an entirely new type of directional transmitter on the ground, operating in the ultra-high-frequency channels. Mounted in the plane is a special ultra-high-frequency receiver which gives an indication of the true azimuth of the transmitting station on the screen of a cathode ray tube. The indication received is entirely independent of the heading of the plane, its attitude, or unsteadiness caused by turbulent air, so that none of the errors common to the use of direction finding equipment mounted in the plane should be encountered. On the practical side the adoption of this system would require the installation of this new range in place of the conventional ranges at all present locations, and in all probability at least one additional range between each two existing ranges to allow for the quasi-optical range of the ultra-high frequencies. This, in itself, is no greater problem than that presented by changing the present radio range system over to ultra-high frequencies but the added problem occasioned by the necessity of re-equipping all planes which are to use the airways with the new type of receiving equipment, the instruction of personnel in the new procedures involved and the confusion which is bound to exist during the change-over period is a very real one. The present receiving equipment is admittedly too heavy and must undergo further refinement before adoption is even considered. During this period of further development several experimental Omnidirectional Radio Ranges should be constructed in some area where extensive flight tests may be carried out to explore completely the possibilities of this system.

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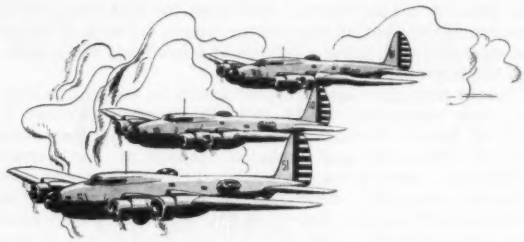

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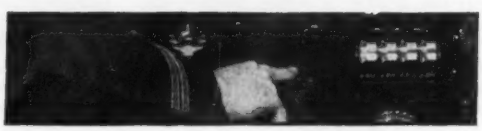

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Long distance stunt flights no longer seem to be in order since there are few places to go which are not covered by regular commercial service employing men trained in long distance flying and navigating. To the professional navigator ease of plotting outweighs many features which might make a map seemingly more intelligible to a novice planning to make one flight, for which a map might be constructed such as the one suggested by Bradley Jones in his paper on "Maps for Long Distance Flights." With the excellent maps and charts which are now available for universal use by air navigators between any two points, it is hard to conceive of any great demand for special maps which are of value between the two points only for which they were constructed.

Maurice K. Laufer and Laurence W. Foskett of the National Bureau of Standards dealt with *"The Daytime Photoelectric Measurement of Cloud Heights."* A detector is used in conjunction with a modulated beam of light for the measurement by triangulation of the heights of clouds in the daytime. An a.c. operated mercury arc lamp is used to obtain the modulated beam. An electronic "Synchronous Switch" is used to eliminate the effect of the varying background brightness of the clouds. The shot noise of the photo tube resulting from the relatively high brightness of clouds during the daytime limits the detection. Dark overcast clouds at an elevation of 9,000 ft. have been detected.

Aviation Medicine

The session devoted to Physiological Problems was very timely. The papers presented supplemented and clarified each other in excellent fashion.

J. R. Poppen of the Bureau of Aeronautics, Navy Dept., defined the *"Requirements of Military Oxygen Supply Apparatus."* These requirements are very much more severe than in the administration of oxygen to a sick man. In military flying one must have, from an aircraft point of view, light weight, economy, uniform installation and simplicity. For the personnel, a supercharged cabin would be far better were it not prohibitive in weight and therefore we must have oxygen. There must be a sufficient supply of oxygen for the mission in hand. Apparatus should be not too bulky, and should be automatic in action, simple and serviceable. It should not be always of the same type but adapted to the task in hand. Thus a reconnaissance airplane may cruise for long periods, and will need a low pressure distributing system to a closed circuit breathing apparatus which will have a maximum of economy of oxygen. In a fighter with rapid ascent and great altitude, the demand or constant flow type of breathing apparatus is required. Apparatus should be available to all personnel aboard the aircraft, wherever they may be located. Another basic requirement is that the partial pressure of oxygen shall be adequate to permit absorption of sufficient weight of oxygen by the blood. The use of oxygen apparatus should not interfere with voice communication. There are advantages and disadvantages in microphones incorporated in the masks or helmets and those applied to the larynx, chest or head. Quite evidently oxygen apparatus constitutes a difficult and comprehensive problem.

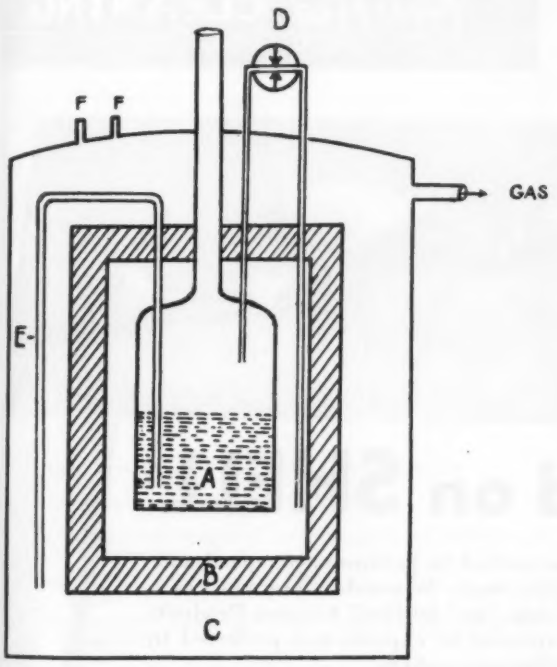

FIG. 4.

It was quite appropriate that John D. Akerman of the University of Minnesota should follow this discussion of oxygen apparatus requirements with a paper on *"The Use of Liquid Oxygen for High Altitude Flying."* During ascent the boiling point of oxygen goes down with decrease in pressure; on descent the boiling point rises, the oxygen stops boiling, and the pilot cannot obtain the necessary supply of oxygen. The author has done much to solve the difficulties involved. If they can be solved, then liquid oxygen should be used again in preference to the tanks of compressed oxygen now in service, as they are very bulky if at high pressure and are vulnerable to gun fire. The use of liquid oxygen would save weight and space. Fig. 4 shows a diagram of the setup developed in connection with the B-L-B(Boothy-Lovelace-Benson) mask of the Mayo Foundation. Liquid oxygen (A) is placed in a closed sheet iron container, (B) is a perforated insulated container filled with glass wool. As the pressure rises rapidly to 45 lbs., and simultaneously in (A), (B) and (C), the supply is ready for use. If the pressure goes above 80 lbs. the two safety valves (F) provide the necessary release. In the meantime, the temperature of the container (A) has dropped and evaporation is lowered with consequent drop in the pressure in the containers (A), (B) and (C) as the result of continuous consumption. The moment the pressure approaches a minimum of 45 lbs., the valve (D) starts to close, raising the pressure in container (A) slightly. This pressure instantly forces liquid oxygen into the U tube and spills liquid oxygen into container (C), and produces a large volume of oxygen gas until enough pressure is produced to open valve (D) again. If at any time the pressure rises above the critical design pressure, the safety valves (F) release the excess pressure. This process is continuous until all the liquid oxygen is used up. The results achieved may be defined as follows: (1) a predetermined pressure of gas is maintained in the liquid container, (2) by supplementing the normal evaporation by spilling a certain amount of liquid oxygen into the gas container, fast evaporation takes place so that a constant supply of gas under all circumstances (particularly descent) is maintained.

Meteorology

Weather still remains a vital factor in airplane operation, and it was appropriate that several papers on practical meteorology should be presented.

J. J. George of Eastern Air Lines gave a paper, *"On the Technique of Forecasting Low Ceiling and Fogs,"* and presented an admirable, practical procedure combining the study of air mass movements, and charts such as the plotting of dewpoint depression at sunset against time of fog formation for different wind directions and velocities in a particular locality. Intensive detailed effort and concentration on a given locality are the keynotes for an airline meteorologist. The author particularly advocated (1) more time for forecasting, (2) preanalysis, that is, work before map is started, (3) indication of prognostic movements on the finished chart, and (4) a logical system of forecasting which may be likened to qualitative chemical analysis (a special form has been developed for this purpose).

Other meteorological papers were of such highly technical character as to permit only brief mention in an engineer's report of the Meeting. Thus in listing *"The Facilities of the*

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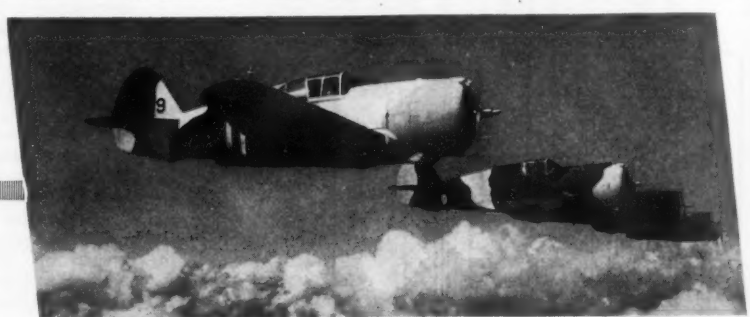

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Temperature-Entropy Diagram for Geopotential Determination and other Essential Meteorological Purposes" by Paul G. Kiefer of the U.S. Navy Postgraduate School one can only say that geopotential energy is the mechanical potential energy which derives from the elevation of an air mass above the earth's surface. The facilities involve barographic soundings and other data, and considerable mathematical work.

Albert W. Friend of Harvard University, in his *"Further Comparisons of Meteorological Soundings by Radio Waves with Radiosonde Data"* stated that radio wave pulse echoes can be utilized for continuous recordings of all meteorological discontinuities to the base of the stratosphere. It has been found in practice and confirmed by calculations that the weaker tropospheric radio wave reflections from discontinuities in upper air regions are made observable only because of a continuous background amplitude level, upon which any slight variations (in synchronism with transmitted pulse timing) may be detected. It is thus possible to record continuously by radio echoes a reflected pulse pattern which is a direct function of the meteorological conditions.

Studying ice formation in the laboratory is most difficult. Therefore, David J. Arenberg of the Blue Hill Meteorological Observatory, and Patrick J. Harney of the U.S. Weather Bureau were perfectly right when they studied nature itself instead of attempting to duplicate its conditions, and choose to work in the clouds of Mount Washington. The use of Mount Washington as a site was ideal because of the high winds and dense fogs that occur there in the winter. *"The Mount Washington Icing Research Program"* attacks (1) measurement of liquid water content, (2) measurement of drop size distribution, (3) structure and physical properties of rain and ice, (4) testing of de-icing equipment, and (5) conditions necessary for severe icing. Aviation is fortunate in having scientific men undertake such studies under disagreeable conditions.

R. B. Montgomery and Athelstan F. Spilhaus of New York University and Woods Hole Oceanographic Institution read: *"Examples and Outline of Certain Modifications in Isentropic Analysis."*

Isentropic analysis in this country originated with a particular purpose in view, namely, as a means of using moisture distribution to determine flow patterns in the atmosphere. It revealed, very successfully, certain theoretically anticipated patterns. Subsequently it has come into general use in connection with upper-air analysis, but for the most part its application is dominated by the original particular purpose. A rather different approach is to use isentropic analysis in a more purely descriptive fashion as the principal tool for upper-air analysis. This demands that an isentropic chart represent synoptically as much useful information as possible, and that all phases of its preparation receive due care.

It is this second approach which the authors are attempting to follow at New York University and which is outlined in the paper. The procedure differs from that followed elsewhere.

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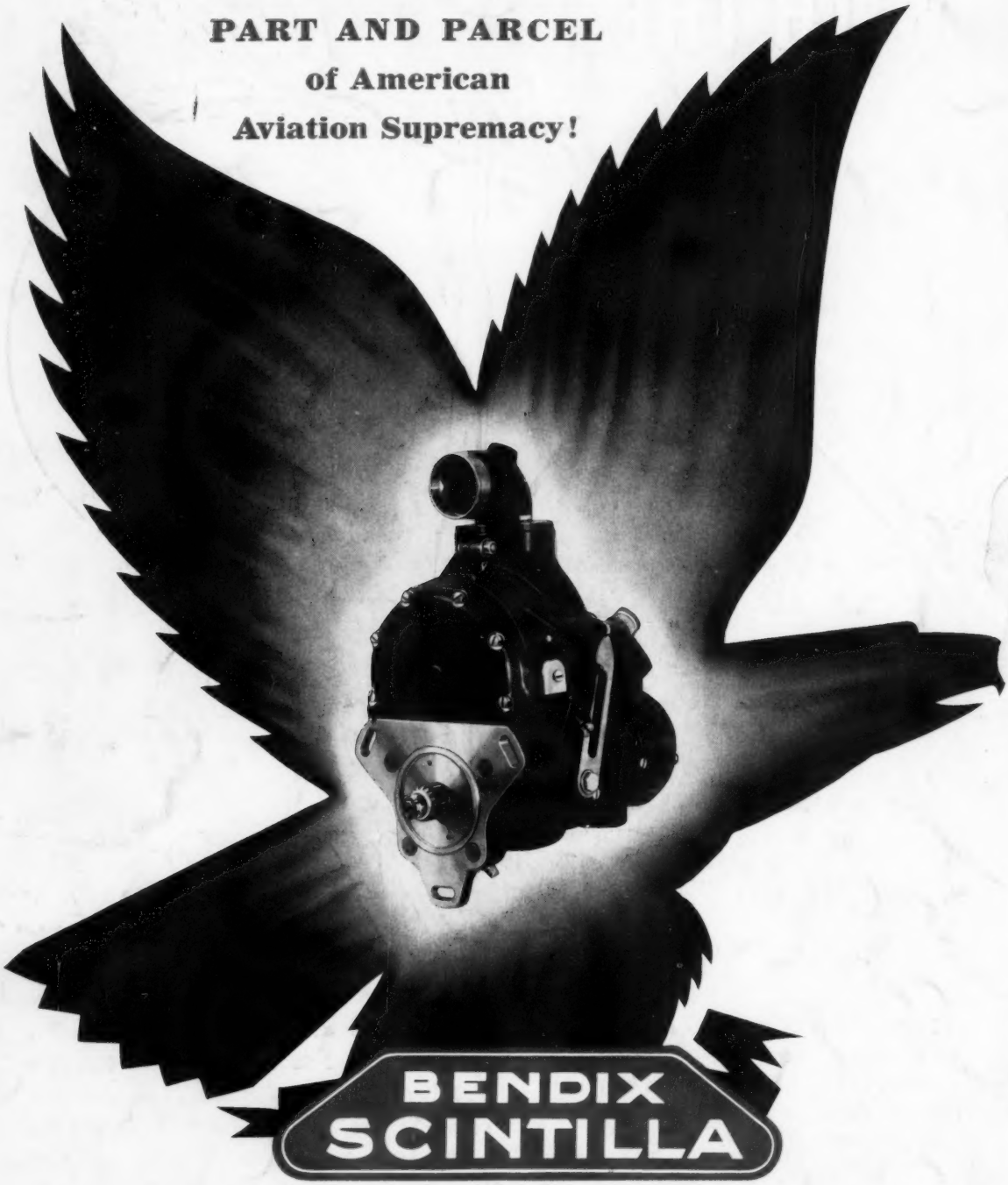

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